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ABSTRACT

On-the-job training literature from both civilian and military sources was reviewed. Selected references from the study are organized under the following headings: literature reviews and bibliographies, handbooks and manuals, cost effectiveness literature, technique comparison studies, systems analysis of training, approaches to program evaluation, and military documents. Many of the items are annotated, some rather extensively. In addition, a number of references were selected that were thought to contain innovative ideas that should be considered for improving on-the-job training programs. The list of possible innovations is organized under the following topics: administration, audiovisual presentation, computer-assisted techniques, evaluation, incentives/motivation, instructional techniques, periodic surveys, and program design. The various ways in which these innovations might address current problems in the Air Force on-the-job training program are described and commented on. Estimates are also made of the resource requirements involved if possible modifications in existing procedures were to be implemented. (Author/PR)

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AFHRL-TR-74-66

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HUMAN RESOURCES

AN ACTION ORIENTED REVIEW OF THE ON-THE-JOB TRAINING LITERATURE

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MARTY R. ROCKWAY, Technical Director
Technical Training Division

Approved for publication.

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The on-the-job training (OJT) literature was reviewed, and selected references were organized in terms of the following categories: literature reviews and bibliographies; handbooks and manuals; cost effectiveness; technique comparison studies; systems analysis of training; approaches to program evaluation; and military documents. In addition, a number of references were selected that are thought to contain innovative ideas that should be considered by people with responsibility for managing and evaluating OJT

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programs. The various ways in which these "innovations" might address current interests or problems in the Air Force OJT program are described. Specific comments are made about the possible advantages associated with each idea. Estimates are also made of the resource requirements involved if modifications to existing procedures or programs were to be implemented.

SUMMARY

The On-The-Job Training (OJT) literature was reviewed, and selected references were organized in terms of the following categories: literature reviews and bibliographies; handbooks and manuals; cost effectiveness; technique comparison studies; systems analysis of training; approaches to program evaluation; and military documents. In addition, a number of references were selected that are thought to contain innovative ideas that should be considered by people with responsibility for improving OJT programs. The various ways in which these "innovations" might address current problems in the Air Force OJT program are described. Specific comments were made about the possible advantages associated with each idea. Estimates were also made of the resource requirements involved if possible modifications in existing procedures were to be implemented.

PREFACE

This handbook is a research product of the exploratory development program of the Technical Training Division, Air Force Human Resources Laboratory. This effort is documented under project No. 1121, Technical Training Development, Task 112105, Application of Systems Analysis to Air Force Technical Training. The services of the American Institutes for Research (AIR) were obtained through contract No. F41609-C-0036.

Dr. Robert W. Stephenson was principal investigator of the technical work that resulted in the conduct of the literature review. Mr. Clifford P. Hahn was coinvestigator. Dr. James R. Burkett, Technical Training Division, was the Air Force contract monitor.

The authors gratefully acknowledge the many contributions of Mrs. Halaine Gary, who collected all the works reviewed, and Mrs. BevAnne Ross, who organized the bibliographic citations and edited the report.

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SECTION I

INTRODUCTION

This is one of several reports describing the work conducted during a two-year study. One of these reports (Stephenson and Burkett, 1973)[1] describes a systems analysis of the Air Force OJT program. One additional report (in two volumes), a "Program Evaluation Guide" for evaluating on-the-job training programs, is planned.

The Air Force on-the-job training (OJT) system is vast and complex, both from a training and a management standpoint. The present OJT system encompasses a wide diversity of technical specialties and command missions, and the system must provide training to a broad mix of trainees having varying aptitudes and levels of Air Force experience. A myriad of training materials, directives, and instructional approaches are used. Because of its diversity and complexity, the OJT process is expensive and difficult to manage. It is also understandably difficult to evaluate in terms of training adequacy and cost effectiveness.

There is a need for better and more easily applied methods of monitoring and evaluating the Air Force OJT program in terms of costs, quality and effectiveness of training provided, determination of optimal OJT-resident school mix, and timeliness in incorporating innovative OJT instructional techniques as they become available. While it is recognized that actual job performance is the ultimate criterion of training success, performance test development and administration are often too costly to be practical in so vast a training system as Air Force OJT. There is, therefore, a need for exploration of new techniques that could improve OJT effectiveness.

Additionally, there is a need to compile the available information about OJT into a single useful source document with recommendations for areas where the Air Force OJT system can be most easily and rapidly improved.

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[1] Stephenson, Robert W. (American Institutes for Research) and Burkett, James R. (Air Force Human Resources Laboratory). "Analysis of the Air Force On-The-Job Training System," Draft Technical Report prepared for Technical Training Division, Air Force Human Resources Laboratory, Lowry Air Force Base, Colorado (in press).

OBJECTIVES OF THE PROJECT

Because of these needs, an Air Force research requirement was formulated and modified as a result of extensive consultations with a variety of interested headquarters locations. The objectives of the investigation were finally stated as follows:

(1) Describe the operation, capabilities, and functional requirements of OJT as presently conducted throughout the Air Force through appropriate application of systems-analysis and cost-analysis techniques.

(2) Identify and document problems being experienced by OJT managers, trainers, and trainees in the field in accomplishing representative OJT programs.

(3) Devise and demonstrate new methods and alternatives for measuring the effectiveness of OJT programs, and recommend ways to apply these methods to improve OJT throughout the Air Force (Statement of Work, Contract No. F41609-72-C-0036, p.1).

PROJECT PHASES

The decision was made to conduct the work in two phases. The first phase would be concerned with problem definition, the second phase with the evaluation of several innovative approaches.

Specific objectives of Phase 1 were:

(1) Review of civilian and military technical literature on OJT as well as all current Air Force regulations, manuals, and other documents governing or describing the OJT system.

(2) Conduct of a systems analysis of the Air Force OJT program to describe what the system is supposed to be, what its programmed functions are, how it is supposed to operate under current directives, and how it relates to other systems and personnel programs.

(3) Determine, through interviews and questionnaire responses, what problems are being experienced in the field in conducting representative OJT programs.

(4) Determine and document the extent of correspondence and interaction between OJT and formal resident training programs.

(5) Make recommendations on how to improve the present Air Force OJT system based upon the results of the overall systems analysis accomplished in objectives (1) through (4), above (Statement of Work, Contract No. F41609-72-C-0036, p. 1).

The present report describes the results of the literature review task (Objective 1).

SECTION II

SCOPE OF LITERATURE REVIEW

The requirements for the Literature Review, to be conducted as part of this project, were stated as follows:

> "During Phase I, the contractor shall conduct and document a thorough, comprehensive review of the literature pertaining to on-the-job training methods, materials, and media. Topics reviewed shall include, but not be limited to, on-the-job training, correspondence technical training, apprenticeship training, field training, and operational training. The contractor shall also be responsible for reviewing and synthesizing all applicable Air Force directives, regulations, and manuals on the Air Force on-the-job training program as well as any parallel or pertinent Army, Navy, or other DOD OJT directives and policy documents" (Statement of Work, Contract No. F41609-72-C-0036, pp. 1-2).

References were selected in accordance with this requirement, and were briefly reviewed by the senior author. Many of the references were literature reviews and bibiliographies assembled by other organizations, so the total number of citations that were considered for inclusion numbered in the thousands. In addition, approximately 50 government documents and manuals were obtained by the contract monitor and forwarded to the principal investigator for possible inclusion in the study.

SOURCES

Relevant references were gleaned from many sources. The literature review covered a period from 1957 through 1973 and was brief in scope, but thousands of references were considered. Computer searches were made of relevant abstracts that are contained in the Educational Resources Information Center (ERIC) and the Defense Documentation Center (DDC) data bases. Special computer lists of unpublished work currently in progress (funded by the Department of Defense) were also obtained and searched. These computer runs produced abstracts of approximately 2,000 relevant reports, documents, and current projects.

Other important sources of references were the existing bibliographies and literature reviews and abstracting services in the area of vocational education. These have been produced on a recurring basis for many years by the Ohio State University Center for Vocational and Technical Education.[2] The focus of most of these references is upon problems of civilian education rather than military education, but many useful citations were found to be applicable to this research. Other bibliographies were reviewed as useful sources of information (e.g., bibliographies of reports produced by organizations that specialize in training research, such as the Human Resources Research Organization (HumRRO), the Naval Personnel and Training Research Laboratory, the Air Force Human Resources Laboratory, etc.).

In addition to these computer searches and secondary sources of literature reviews, special independent reviews were conducted of recent journals that were likely to have information about training innovations and research. The *Training and Development Journal* of the American Society for Training and Development, for example, was a "gold mine" source of information. It contained abstracts of articles that were selected because they were considered useful for people in the training field. Other relevant sources included such publications as the *Journal of Applied Psychology, and Personnel Psychology*.

The training literature is not very inspiring. Campbell (1971)[3] conducted a review of the personnel training and development literature in 1971 and summarized his views as follows:

"By and large, the training and development literature is voluminous, nonempirical, nontheoretical, poorly written, and dull . . . it is faddish to the extreme. The fads center around the introduction of new techniques and follow a characteristic pattern. A new technique appears on the horizon and develops a large stable of advocates who first describe its 'successful' use in a number of situations. A second wave of advocates busy themselves trying out numerous modifications of the basic technique. A few empirical studies may be carried out to demonstrate that the technique 'works.' Then the inevitable backlash sets in, and a few vocal opponents begin to criticize the usefulness of the technique, most often in the absence of data. Such criticism typically has very little effect. What does have an effect is the appearance of another new technique and a repetition of the same cycle.

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[2] Center for Vocational and Technical Education. *Abstracts of Research and Related Materials in Vocational and Technical Education* (ARM), a quarterly publication of the ERIC Clearinghouse on Vocational and Technical Education.

[3] Campbell, John P., "Personnel Training and Development," in Mussen, P. and Rosensweig, M. (eds.), *Annual Review of Psychology*, Vol. 22, 1971, pp. 565-566, Annual Reviews, Inc., Palo Alto, Calif., 1971.

"Another recurring phenomenon is the cyclical article. That is there are several prototype papers that appear in the literature at regular intervals. For example, there is the article admonishing people to evaluate their training efforts. There is another which argues that training should be well-planned and systematic. Yet another reminds us that training and development efforts must have the support of top management or they will fail. There are 5-10 of these basic types, which say the same things over and over again in almost the same language." (Campbell, 1971)[4]

We found the literature on OJT to be essentially as Campbell describes it. Most references were quickly rejected on the grounds that they contained nothing new or that they were concerned with formal classroom training rather than OJT. We were not, however, only concerned with experiments that proved something. Our own literature review was much more tolerant than Campbell's, since we also sought manuals and procedural guidelines that could be used by non-experts to evaluate training programs. We were also interested in new ideas, whether they had been proved valid or not.

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[4] Reprinted, with permission, from "Personnel Training and Development," *Annual Review of Psychology*, Volume 22, pages 565-566, Copyright, 1971 by Annual Reviews, Inc. All rights reserved. Permission to quote is also given by the author, John P. Campbell.

CONDUCT OF THE LITERATURE REVIEW

The work started by gathering bibliographies and literature reviews. These were reviewed, and those citations and abstracts that were deemed interesting or pertinent were collected. During a period of several months, the selected references were obtained. The senior author reviewed the mass of references and chose those works that were to be included for bibliographic citation. Each reference was identified and placed into one or more of the following categories:

Literature Reviews and Bibliographies
Handbooks and Manuals
Training Cost-Effectiveness Literature
Technique Comparison Studies
Systems Analysis of Training
Approaches to Program Evaluation
Military Documents
Innovations

The report is organized accordingly. A selected bibliography accompanies each of the following sections of this report. Wherever abstracts were available, they have been included. An author index is also provided.

SECTION III

LITERATURE REVIEWS AND BIBLIOGRAPHIES

The training literature is frequently reviewed, and bibliographies (annotated and otherwise) exist in great numbers. Some indication of the mass of the literature can be gleaned from the large number of citations (449 in one reference and 213 in another) cited in very selective literature reviews of the work performed during recent years (Smith, 1967;[5] Campbell, 1971[6]).

The Ohio State Center for Vocational and Technical Education is a regular source of references in this area, since they publish literature reviews regularly under contract with the U.S. Department of Health, Education, and Welfare, Office of Education. In addition to these general sources, a number of specialized literature reviews and bibliographies concerned with specific subject-matter areas were searched.

The literature and state-of-the-art reviews and bibliographies that seemed most relevant for OJT are presented in this section.

BIBLIOGRAPHY

Barlow, Esther. *Abstracts of Personnel Research Reports: VIII.* 1954-1968, Technical Report AFHRL-TR-68-124, Air Force Human Resources Laboratory, Personnel Research Division. Lackland AFB, Texas, December 1968. AD-695 483.

Begle, Elsie P., Dunn, James A., Kaplan, Robert M., Kroll, John, Melnotte, Judith M., Steel, Lauri. *Career Education: An Annotated Bibliography for Teachers and Curriculum Developers,* American Institutes for Research, Palo Alto, Calif., January 1973.

Bergman, B.A. and Siegel, A.I. *Training Evaluation and Student Achievement Measurement, A Review of the Literature,* Technical Report AFHRL-TR-72-3, Technical Training Division, Air Force Human Resources Laboratory, Lowry AFB, Colorado, January 1972. AD-747 040.

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[5] Smith, Robert G., Jr. *An Annotated Bibliography on the Design of Instructional Systems,* Technical Report 67-5, The George Washington University, Human Resources Research Office, Alexandria, Va., May 1967.

[6] Op. cit., Campbell 1971.

Bilodeau, E. A. *Principles of Skill Acquisition*, Academic Press, New York, 1969.

Briggs, L. J. *Sequencing of Instruction in Relation to Hierarchies of Competence*, Monograph 3, American Institutes for Research, Pittsburgh, Pa., 1968.

Campeau, P. L. "Selective Review of Literature on Audiovisual Media of Instruction," in Briggs, L. J. et al., *Instructional Media: A Procedure for the Design of Multi-Media Instruction, a Critical Review of Research, and Suggestions for Future Research*, Monograph 2. American Institutes for Research, Pittsburgh, Pa., pp. 99-142, 152-176.

A review of educational literature considered most pertinent to the selection and use of appropriate audiovisual media for achieving given learning requirements is presented. Three types of research are reported: comparative effectiveness studies (comparison of a new medium to conventional methods or to other new media); utilization studies (comparing methods of using a given medium); and basic studies (highly analytical studies that seek to explore media and learner variables that may be related to achievement). Included are studies conducted in educational institutions from elementary school through the university. Excluded are production studies, military research, attitudinal and motivational research, and media-preference research. Research literature of the three types is reported for each of the following: television; motion pictures; programmed instruction (primarily linear, paper and pencil programs); filmstrips, slides, transparencies, and other pictorial presentations; radio and recordings; three-dimensional models; and field trips. Limitations of current educational research and a suggested strategy for future research on media conclude the chapter.--*Auth.*

Chalupsky, Albert P., and Kopf, Thomas J. *Job Performance Aids and Their Impact on Manpower Utilization*, WDL TR 3276 (prepared for Office of Manpower Policy, Evaluation and Research, Department of Labor) WDL Division, Philco-Ford Corp., Palo Alto, Calif., May 1967. (PB 175 608)

Childs, Gayle B. "Review of Research in Correspondence Study," in Wedemeyer (ed.), *The Brandenburg Memorial Essays on Correspondence Instruction: II*. University of Wisconsin Press, Madison, Wis., 1966, pp. 126-140.

Research is not a notable emphasis in the field of correspondence study. There is, however, a persistent and continuing effort on the part of some institutions to carry on research programs, and a notable improvement in research studies. The next five years may bring increased recognition of the importance of research to correspondence education.--*Auth.*

Christal, R.E. "Implications of Air Force Occupational Research for Curriculum Design," in Smith, B.B. and Moss, J., Jr. (eds.), *Report of a Seminar: Process and Techniques of Vocational Curriculum Development,* Minnesota Research Coordinating Unit for Vocational Education, University of Minnesota, Minneapolis, 1970.

Cunningham, J.W. *"Ergometrics": A Systematic Approach to Some Educational Problems,* Center Monograph No. 7, Center for Occupational Education, North Carolina State University, Raleigh, North Carolina, 1971.

Cunningham, J.W. (ed.), *The Job-Cluster Concept and its Curricular Implications: A Symposium,* Center Monograph No. 4, Center for Occupational Education, North Carolina State University, Raleigh, North Carolina, 1969.

DeCrow, Roger and Grabowski, Stanley M. (eds.), *Research and Investigation in Adult Education: 1970 Annual Register,* ERIC Clearinghouse on Adult Educaton, Adult Education Association of the USA, Washington, D.C., 1970. (ED 045 866)

Embracing 750 items on adult education research and investigation (mostly dated 1969 or 1970), this annotated bibliography covers adult learning characteristics, program planning and administration, learning environments, instructional methods, curriculum materials and instructional devices, personnel and staffing; education of specific clientele groups, special program areas, professional and technical continuing education, management and supervisory development, occupational training, labor education, institutional sponsors, and international perspectives in adult education.--*Auth.*

Ebel, Robert L., Noll, Victor H., and Bauer, Roger M. *Encyclopedia of Educational Research* (Fourth Edition), A Project of the American Educational Research Association, The MacMillan Co., Collier-MacMillan Limited, London, 1969.

Finch, G. (ed.)., *Symposium on Education and Training Media,* National Academy of Sciences, National Research Council, Washington, D.C., 1960.

Foley, J.P., Jr. *Job Performance Aids Research, Summary and Recommendations,* Air Force Human Resources Laboratory, Wright-Patterson AFB, Ohio, April 1969. (AD 697 034)

Foley, J.P., Jr. *Performance Testing: Testing for What Is Real,* Memorandum AMRL P-42, 6570th Aerospace Medical Research Laboratories, Aerospace Medical Division, Wright-Patterson AFB, Ohio, June 1963. (AD 412 776)

Galanter, E.H. (ed.). *Automatic Teaching: The State of the Art,* John Wiley, & Son, New York, 1959.

Geis, G.L. *Behavioral Objectives: A Selected Bibliography and Brief Review,* ERIC Clearinghouse on Media and Technology, Stanford, Calif., April 1972.

The purpose of this paper is to identify and organize the major topics in the area of behavioral objectives and to present a sampling of the literature in that area. (Note: Where a reference is made to the same source in two different sections, the reference is repeated in each bibliography for the convenience of the reader.)

No attempt has been made to produce a comprehensive bibliography. This Herculean task fortunately has been carried out by others. The Canadian Teachers' Federation (1971) has recently made available a large and comprehensive bibliography of books, articles, and papers totaling more than 350 items. Poulliotte and Peters (1971) have produced an even larger bibliography. It is not annotated, but it is divided into several sections for easier searching and is an invaluable source to the student.

A number of books contain articles or chapters discussing behavioral objectives. The most comprehensive collection is a recent book by Kapfer (1971), which includes about 40 separate articles on such topics as: "Behavioral objectives and the teaching of values," "Behavioral objectives and the educational technologist," and "Classifying objectives to improve instruction."--*Auth.*

Glaser, Robert (ed.). *Teaching Machines and Programmed Learning. II. Data and Directions,* DAVI, National Education Association, Washington, D.C., 1965, 832 pp.

Glaser, Robert (ed.). *Training Research and Educaton,* University of Pittsburgh Press, Pittsburgh, 1962.

One of the essential obligations of a society at peace is the education of its members. It is also true that an essential mission of a military establishment during peacetime is the training of its personnel. Both education and training have a common basis in the findings of psychological research. This book examines training research accomplished by experimental psychologists, and considers the implications of the research for education in general.

A good portion of the work performed by the individuals involved in this effort has been devoted to research and development in problems of training and the underlying phenomena of learning that are involved. The results of this endeavor are obviously relevant not only to specialized military problems, but to civilian education and to the science of learning. A unique aspect of this work is the fact that an increasing number of persons trained in experimental psychology have been turning their attention to the problems of training and education. In the light of the expressed concern of the United States with education, this meeting of science and education is of great interest. The purpose of this volume is to present a representative account of the training research that has been performed and to examine its implications for psychological research and for training and education.

Goodman, Edith H. (ed.). *Automated Education Handbook*, Automated Education Center, Detroit, Michigan, 1965.

Grabowski, Stanley M. (ed.). *Research and Investigation in Adult Education: 1971 Annual Register*, ERIC Clearinghouse on Adult Education, Syracuse, New York; and Adult Education Association of the USA, Washington, D.C., 1971.

This is an annotated bibliography including 578 items of research or investigation in adult education, mostly dated 1970 or 1971. They cover adult learning characteristics, program planning and administration, learning environments, instructional methods, curriculum materials and instructional devices, personnel and staffing, education of particular groups, program areas, professional and technical continuing education, management and supervisory development, labor education, occupational training, institutional sponsors, and international perspectives in adult education.--*Auth.*

Hansing, Ruth A. and Matlock, Eugene W. *A Survey of Training-Related Utilizations of Television*, Research Report SRR 70-19, Naval Personnel and Training Research Laboratory, San Diego, Calif., February 1970. (AD 701 698)

This report provides a broad survey of the current state of television training technology in civilian and military situations including detailed information concerning a variety of specific applications at local Naval training facilities in the San Diego area. The relative effectiveness of the existing conventional and unique uses of television is studied and recommendations are made regarding the feasibility of applying existing systems to other Navy contexts or to developing modified or innovative systems.

The research information presented includes data pertaining to specific equipments, personnel requirements, cost, and training factors associated with typical television systems.

The effectiveness of television, as a potent and diversified training tool, is confirmed in a wide variety of research findings and demonstrated in a broad range of operational training situations. The most prevalent training use of television is simply as a device to present filmed instructions in a classroom. The more effective utilizations of television, however, appear to be those applications that capitalize on the unique capabilities of the medium, such as in providing immediate performance feedback or in supplying visually programmed task direction.--*Auth.*

Hickey, A. E. (ed.). *Computer-Assisted Instruction: A Survey of the Literature* (3rd ed.). Entelek, Inc., Newburyport, Mass., 1968.

Householder, D. L. and Suess, A. R. *Review and Synthesis of Research in Industrial Arts Education* (2nd ed.). ERIC Clearinghouse, The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, Columbus, Ohio, October 1969. (ED 034 398)

Impellitteri, Joseph T. and Finch, Curtis R. *Review and Synthesis of Research on Individualizing Instruction in Vocational and Technical Education,* Information Series No. 43 (VT 013 338), ERIC Clearinghouse on Vocational and Technical Education, Columbus, Ohio, December 1971.

In the reporting of individualized instruction research and development activities, priority was placed upon investigations that dealt with instructional problems within the general parameters of vocational and technical education. Other studies were discussed outside those parameters when it was perceived to be necessary for a more adequate coverage of the topic under discussion. Individualized instruction efforts in areas highly related to vocational and technical education (military training, industrial training, and other areas of education) were thus included. No attempt was made, however, to prepare a thorough review of research in those related areas.

The materials used in this review and synthesis were gathered from several places. A number of useful reports were identified through the computer search conducted by the ERIC Clearinghouse at Ohio State University. As a result of contacting state Research Coordination Unit directors, several other meaningful items were obtained. *Dissertation Abstracts* served as a prime source for relevant doctoral theses. Contacts with key personnel in military training research resulted in the inclusion of many meaningful research efforts from this sector.--*Auth.*

Keller, Claudia Merkel. *Criterion-Referenced Measurement, a Bibliography*, TM Reports No. 7, ERIC Clearinghouse on Tests, Measurement, and Evaluation, Educational Testing Service, Princeton, N.J., January 1972.

Kerlinger, Fred N. (ed.). *Review of Research in Education*, F. E. Peacock, Itasca, Ill., 1973.

Critical and synthesizing essays on four areas of educational research: learning and instruction; school organization, effectiveness, and change; research methodology--multivariate analysis; and history of education.--*H.G.*

Kurtz, Albert K. and Smith, Mary C. *Annotated Bibliography of Human Factors Laboratory Reports (1945-1968)*. Technical Report NAVTRADEVCEN IH-158, Naval Training Device Center, Human Factors Laboratory, Orlando, Florida, February 1969, 369 pp.

Lapp, Diane. *The Use of Behavioral Objectives in Education*, ERIC/CRIER and the International Reading Association, The International Reading Association, Newark, Delaware, 1972.

A behavioral objective has been defined by R. F. Mager as a statement telling the conditions under which a specified behavior will occur (external conditions), the type of behavior that is to occur as a result of planned instruction (terminal behavior), and the performance level that will be accepted (acceptable performance). The term *behavioral objective* has accumulated the following synonyms that appear frequently in educational literature: goals, instructional objectives, educational objectives, performance objectives, and training objectives.

This paper, which accepts Mager's definition, begins by reviewing the literature dealing with behavioral objectives. The literature is divided into four categories: 1) educational significance of behavioral objectives, 2) evaluation of student learning and of the instructional program through behavioral objectives, 3) student awareness of and participation in behavioral objectives, and 4) teacher training in the development and use of behavioral objectives.

The section that follows is a synthesis of the strengths and weaknesses of the research reviewed. The final section proposes recommendations for future research, including a thinking process proposed by the author for use by the classroom teacher when planning and evaluating the instructional program.--*Auth.*

Larson, Milton E. *Review and Synthesis of Research: Analysis for Curriculum Development in Vocational Education,* Information Series, ERIC Clearinghouse on Vocational and Technical Education, The Ohio State University, Columbus, Ohio, October 1969. (ED 035 746)

Lewis, Wiley B. *Review and Analysis of Curricula for Occupations in Construction,* Information Series No. 24 (VT 011 753), ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, October 1970.

References believed to be of value to persons desiring information relating to the planning of curricula for new occupations in the construction industries were identified through a search of both ERIC publications and non-ERIC publications. ERIC publications included:

Abstracts of Instructional Materials in Vocational and Technical Education (AIM), Fall 1967-Spring 1970.

Abstracts of Research and Related Materials in Vocational and Technical Education (ARM), Fall 1967-Spring 1970.

Current Index to Journals in Education, Vol. I, Vol. II, Numbers 1-3.

Manpower Research: Inventory for Fiscal Years 1966 and 1967.

Manpower Research: Inventory for Fiscal Year 1968.

Research in Education (RIE) Volumes I-IV; Volume V, Numbers 1-7.

The three non-ERIC sources of information that were searched were:

CIRF Abstracts. The International Vocational Training Information and Research Centre, C/O The International Labor Organization, Volume I-VIII; Volume IX, First Dispatch, Geneva, Switzerland, (February 1970).

Corplan Associates of IIT Research Institute. *A Bibliography of Published and Unpublished Vocational and Technical Education Literature,* Research Coordinating Unit, Vocational and Technical Education Division and State of Illinois, Board of Vocational Education and Rehabilitation, Illinois, 1966.

Ehrenreich, Julia W. (ed.). *Education Index,* The H.W. Wilson Company, New York, July 1964-May 1970.

An additional search was made of the *Research in Education* indexes by computer in an attempt to identify material related to curricula development in the construction industries.

Lewis, Wiley B. *Review and Analysis of Curricula for Occupations in Food Processing and Distribution*, Information Series No. 32, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, December 1970. (ED 045 820)

Lewis, Wiley B. *Review and Analysis of Curricula for Occupations in Health*, Information Series No. 27, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio November 1970. (ED 044 507)

Lewis, Wiley B. *Review and Analysis of Curricula for Occupations in Public Services*, Informational Series No. 29, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, November 1970. (ED 045 813)

Lewis, Wiley B. *Review and Analysis of Curricula for Occupations in Transportation*, Information Series No. 28, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, December 1970. (ED 045 814)

Lumsdaine, A.A. and Glaser, Robert (eds.). *Teaching Machines and Programmed Learning: A Source Book*, National Education Association. Department of Audio-Visual Instruction, Washington, D.C., 1960.

McCord, Mary F. *ERIC Products 1970-1971, An Annotated Bibliography of Information Analysis Publications of The ERIC Clearinghouses, July 1970 through June 1971*, ERIC Clearinghouse on Library and Information Sciences, American Society for Information Science, Washington, D.C., September 1971.

Mathieson, David E. *Correspondence Study: A Summary Review of the Research and Development Literature*, ERIC Clearinghouse on Adult Education, Syracuse, New York, March 1971.

Beginning with a historical review of private correspondence schools, supervised high school level programs, military programs (notable the United States Armed Forces Institute), and activities by such university extension luminaries as William Rainey Harper and W.

H. Lighty, this literature review covers accreditation and licensing problems, general characteristics of students, educational methods and course design, and patterns of student methodology. Limitations affecting the effective use of correspondence study are assessed, along with the instructor role, steps in planning course content and materials, and the structuring of assignments and instructor response (feedback). Expected trends in the use of programmed instruction, broadcast media, films and other audio-visual resources, small groups, special degree programs, and arrangements for course credits and degrees through examinations, are also suggested. Annotated chapter bibliographies contain 164 references.--*L.Y.*

Mathieson, Moira B. *A Bibliography of Bibliographies on Career and Vocational Education,* Part II of the ERIC Clearinghouse on Teacher Education Project on Career Education, (SP 005 880), Washington, D.C., October 1972. (ED 067 387)

Mesics, Emil A. *Education and Training for Effective Manpower Utilization: An Annotated Bibliography on Education and Training in Work Organizations,* Bibliography Series No. 9, New York State School of Industrial and Labor Relations, Ithaca, New York, March 1969, 157 pp.

The training function in organizations has grown in magnitude and status since its inception as a part of the formal structure in the early 1940. This bibliography is designed to cover the relevant and pertinent literature that has been concurrent with the growth and changed status of the training function. The major purpose of this volume is to serve the practitioner and student as a ready reference to the practices and theories on which concepts about learning at the workplace have emerged and developed. The references cited are drawn from the sparse literature, which appeared early in the century, to the abundant and varied current writings in books and periodicals.

The volume was assembled and organized so that the practitioner can find ready sources to help him cope with immediate day-to-day training problems. These problems may deal with the application of learning concepts and theories at the adult level across the wide work-force spectrum. Included are references to the handling of new employees in the process of initial orientation and job instruction as well as references to the retraining of older workers who are promoted to new jobs or who are, for one reason or another, transferred to jobs requiring new knowledges and skills. Covered also are situations dealing with technician training and the handling of engineering skill obsolescence. The training specialist can also find references to a variety of methods and techniques for supervisor and manager development in his organization.--*Auth.*

Naylor, J.C. and Briggs, G.E. *Long-Term Retention of Learned Skills: A Review of the Literature*, Technical Report ASD-TR-61-390, August 1961. (AD 267 043)

Pautler, Albert J. and Schaefer, Carl J. *Review and Synthesis of Research in Trade and Industrial Education*, Information Series, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, September 1969. (ED 036 638)

Price, R. G. and Hopkins, C. R. *Review and Synthesis of Research in Business and Office Education* (2nd ed.). Research Series No. 55, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, April 1970. (ED 038 520)

The review was, in general, limited to work completed during the period 1966-1968. In order to identify research completed during that period, the reviewers searched the usual library sources. Another phase of the search was a mail survey of representatives of the National Association for Business Teacher Education, state supervisors, and teacher educators.

Because of the need to include only those studies relating to the topics covered in the review, efforts were made to screen the report by: 1) title, 2) abstract, and 3) primary source. As a result of this screening, some pertinent reports may have been overlooked.

Research studies included are primarily those that are relevant to business and office preparation at senior high schools and two-year post-secondary schools. Also included are reports pertaining to business teacher education.--*Auth.*

Rose, A.J. and Turner, T.B. *Skill Loss: An Assessment of Evaluation Techniques Used by Other Services and Their Application to Navy Technical Ratings*, PRL Report No. WRM 67-24, Naval Personal Research Laboratory, Washington, D.C., January 1967. (AD 649 554)

This report represents the initial phase of research in the design and development of techniques to reduce loss of technical skills, caused by sustained non practice of the skills. The greatest incidence of skill loss in the Navy is presently considered to occur when personnel are assigned to non-rating related billets ashore.

This report is primarily a bibliographic survey of research previously or currently conducted by the Navy and other military services. Conclusions drawn from this survey are: 1) most of this

research concerns operating rather than maintenance skills and has to do with perfecting initial training methods that will prolong job-skill retention, 2) specific research in progress is mainly oriented toward the long-term memory of motor skills or complex, interacting team skills on integrated systems, and 3) there is a conspicuous lack of research related to the loss of skills caused by non-practice to those skills.

The report recommends that subsequent research be directed toward: 1) identifying ratings and skills levels of ratings in which loss presently occurs, 2) determining the extent of skill loss encountered, and 3) determining in each instance specific courses of action designed to enhance rating skill retention.--*Auth.*

Schultz, D.G. and Siegel, A.I. *Post-Training Performance Criterion Development and Application: A Selective Review of Methods for Measuring Individual Differences in On-the-Job Performance,* Applied Psychological Services, Wayne, Pa., July 1961.

Sivatko, John R. "Correspondence instruction," in Ebel, Robert (ed.). *Encyclopedia of Educational Research* (4th ed.), Macmillan, New York, 1969, pp. 213-218.

Smith, Robert G., Jr. *An Annotated Bibliography on the Design of Instructional Systems,* Technical Report 67-5, The George Washington University, Human Resources Research Office, Alexandria, Va., May 1967.

Smith, Robert G., Jr. *An Annotated Bibliography on the Determination of Training Objectives,* Research Memorandum, The George Washington University, Alexandria, Va., June 1964.

Snyder, T.R. and Butler, R.L. *Review and Analysis of Curricula for Occupations in Metalworking,* Information Series No. 25, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, October 1970. (ED 044 495)

Tennyson, Robert D. "A Review of Experimental Methodology in Instructional Task Sequencing." AV Communication Review, Vol. 20, No. 2, Summer 1972, pp 147-159.

Twelker, P.A., Urbach, F.D., and Buck, J.E. (U.S. International University in Oregon, Corwalls, Oregon), *The Systematic Development of Instruction: An Overview and Basic Guide to the Literature,* ERIC Clearinghouse on Media and Technology, Stanford, Calif., March 1972.

Ugelow, A. *Motivation and the Automation of Training: A Literature Review,* Technical Documentary Report MRL-TDR-62-15, March 1962. (AD 277-287)

U.S. Department of Health, Education, and Welfare, Public Health Service. *Training Methodology, Part III: Instructional Methods and Techniques; an Annotated Bibliography,* Public Service Publication 1962, Part III, National Communicable Disease Center Training Program, Washington, D.C. 1969.

U.S. Department of Health, Education, and Welfare, Public Health Service. *Training Methodology. Part IV: Audiovisual Theory, Aids and Equipment; an Annotated Bibliography,* Public Health Service Publication 1962, Part IV, National Communicable Disease Center Training Program, Washington, D.C., 1969.

U.S. Department of the Air Force. Air Force Human Resources Laboratory, Personnel Research Division. *Abstracts of Technical Reports, 1969-1971* (Supplement to Abstracts of Personnel Research Reports: VIII. 1954-1968), Lackland AFB, Texas, December, 1971.

Includes abstracts of 48 technical reports issued by Personnel Research Division from January 1969 through December 1971.--*H.G.*

U.S. Department of the Army. *Planning and Evaluation of Personnel Management Programs, A Bibliographic Survey,* DA Pamphlet 600-9, Washington, D.C., 1 September 1969.

U.S. Department of Labor, Library. *Cost-Benefit Analysis: Theory and Application to Manpower Training Programs; A Bibliography,* Current Bibliography No. 3, Washington, D.C., May 1971, 44 p. (PB 202 158)

U.S. Department of Labor, Library. *Program and Training Evaluation: Selected References,* Washington, D.C., April 1973.

U.S. Department of the Navy. *Bibliography and Abstract of Technical Reports July 1969 to June 1970,* WRR 71-2, Naval Personnel Research and Development Laboratory, Washington Navy Yard, Washington, D.C., October 1970.

Valverde, Horace H. and Youngs, Eleanor J. *Annotated Bibliography of the Training Research Division Reports (1950-1969),* Technical Report AFHRL-TR-69-11, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base, Ohio, September 1969. AD-865 713.

Annotated Bibliography of technical reports and other publications (memo reports, journal articles) on research conducted by the Training Research Division covering period July 1950 through July 1960.--*H.G.*

Valverde, Horace H. *Maintenance Training Media: An Annotated Bibliography,* Technical Report AMRL-TR-67-151, May 1968. (AD 673 371)

Warmbrod, Catharine P. *Review and Synthesis of Literature on Residential Schools in Vocational and Technical Education,* Information Series, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio. December 1970. (ED 045 821)

This *Review and Synthesis of Research on Cooperative Vocational Education* is one of a series of "State-of-the-art" papers in vocational and technical education and related fields. It should assist in identifying substantive problems and methodological approaches for researchers and curriculum development specialists, as well as providing practitioners with a summary of research findings that have application to educational programs. In the field of vocational and technical education, the pace of research and development activities has increased considerably during the period under review.

As one of a series of information analysis papers released by the ERIC Clearinghouse on Vocational and Technical Education, this review is intended to provide researchers, curriculum development specialists, and practitioners with an authoritative analysis of the literature in the field. Those who wish to examine primary sources of information should utilize the bibliography. Where ERIC Document numbers and ERIC Document Reproduction Service prices are cited, the documents are available in microfiche and hard copy forms.--*Auth.*

Weisgerber, R. A. (ed.). *Perspectives in Individualized Learning,* F. F. Peacock Publishers, Inc., Itasca, Ill., 1971, 406 pp.

The readings presented are an analysis of selected factors underlying the process of individualized learning. The book is organized topically and moves from theoretical considerations toward an analysis of important educational components. The readings come from a cross section of experts representing the areas of learning theory, individual differences, measurements and evaluation, educational objectives, teacher roles, learning activities, facilities technology, and computer systems. Each chapter is prefaced with an introduction by the editor. Chapter topics include: underlying assumptions concerning the need for individualized learning, mental abilities as a possible basis for individualization, the impact of individual differences on reading, the measurement and accommodation of individual differences, educational objectives, evaluation, the changing role of the teacher, individualized and interactive learning activities, the instructional environment, and computer-assisted instruction. --*Auth.*

Weinrich, Ralph C. *Review and Synthesis of Research on the Administration of Vocational and Technical Education*, Information Series, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, March 1970 (ED 037 542)

Wood, W.D. and Campbell, H.P. *Cost-Benefit Analysis and the Economics of Investment in Human Resources. An Annotated Bibliography*, Bibliography Series No. 5, Industrial Relations Centre, Queen's University, Kingston, Ontario, Canada, 1970, 217 pp. (ED 045 848)

This annotated bibliography presents 389 citations of periodical articles, monographs, and books, and represents a survey of the literature as related to the theory and application of cost-benefit analysis. Listings are arranged alphabetically in these eight sections: (1) Human Capital, (2) Theory and Application of Cost-Benefit Analysis, (3) Theoretical Problems in Measuring Benefits and Costs, (4) Investment Criteria and the Social Discount Rate, (5) Schooling, (6) Training, Retraining and Mobility, (7) Health, and (8) Poverty and Social Welfare. Individual entries include author, title, source information, "headings" of the various sections of the document which provide a brief indication of content, and an annotation. This bibliography has been designed to serve as an analytical reference for both the academic scholar and the policy-maker in this area.--*Auth.*

SECTION IV

HANDBOOKS AND MANUALS

Generalized "how-to-do-it" handbooks and manuals have been developed for OJT programs in many different organizations. There are also specialized manuals concerned with specific techniques.

The citations in this section are of interest to those who have responsibility for designing new manuals for specific organizations as well as to those who are looking for guidance regarding how to approach specific problems in OJT.

BIBLIOGRAPHY

Allen, D., Hahn, B. J., Johnson, M. P., and Nelson, R. S. *Polysensory Learning Through Multi-Media Instruction in Trade and Technical Education,* Division of Vocational Education, University of California, and Bureau of Industrial Education, California State Department of Education, Los Angeles, Calif., 1968. (ED 022458)

This report explains a teaching system designed to stimulate polysensory learning by use of multimedia instructional materials, which use as many of the physical senses as practical to augment traditional instruction. They include motion pictures, filmstrips, audio tapes, models, mock-ups, etc., according to school facilities and course needs. Care should be used in buying such expensive media as 8mm sound films, since technical instruction needs constant updating; tapes and filmstrips are low in cost and easy to produce. The system is planned for use by each student at a study booth providing privacy and protection from distraction. The student may use the material at his own pace, before or after a shop, laboratory, or small-group discussion. This system is expected to stimulate motor skills, cognitive learning, and the concomitant attitudes of appreciation, responsibility, etc., appropriate to the student's maturity. This individualized instruction and traditional teaching are compared in detail by objective, technique, work method, evaluation, and the role of advisory committees, supervisors, or administrators. Ideally the multimedia method is so organized and used that the program is systematically evaluated and revised to meet realistic student performance goals efficiently. Details of the system, examples of its use, methods of preparing the materials, evaluation of its results, and its future possibilities are presented.--*H.H.*

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Barber, J. W. (ed.). *Industrial Training Handbook*, A. S. Barnes and Company. New York, 1969.

This book may be used with the related six filmstrip series, "ON-THE-JOB TRAINING" and leader's guide, also available from Addison-Wesley--*Auth.*

Bolton, Dale L. *Teacher Evaluation*, PREP Report No. 21, (Putting Research Into Educational Practice Series), U. S. Department of Health, Education, and Welfare, Office of Education, National Center for Educational Communication, DHEW Publication No. (OE) 72-9, Washington, D. C., 1972.

All teachers *are* evaluated. Regardless of how formal the system for evaluation is, what evidence is collected or analyzed, how often formal reports are written--teachers are evaluated and they are evaluated rather often. Students, parents, other teachers, administrators and supervisors, and even the public evaluate teachers. The question facing both administrators and teachers, then, is not whether teachers *should* be evaluated, since this cannot be avoided; rather the question is how systematic the evaluation should be in order to be most effective.

Effectiveness must be in terms of certain purposes desired for the school district; and the design of the evaluation system should include ways of collecting and processing information, communicating with the people concerned, making decisions, and assessing how well the evaluation system works.--*Auth.*

Briggs, L. J. *Handbook of Procedures for the Design of Instruction*, Monograph 4, American Institutes for Research, Pittsburgh, 1970.

Briggs, L. J., Campeau, P. L., Gagné, R. M., and May, M. A. *Instructional Media: A Procedure for the Design of Multi-media Instruction, a Critical Review of Research and Suggestions for Future Research*, Monograph 2, American Institutes for Research, Pittsburgh, 1967.

Broadwell, Martin M. *The Supervisor and On-the-Job Training*, Addison-Wesley, Reading, Mass., 1969.

Here's an easy-to-understand approach to on-the-job training for the individual supervisor. The book is a suitable handbook for trainers on how to do OJT.

Using a systematic, but nontechnical approach, chapters cover Why Train; How People Learn: OJT or Classroom Training?; Analyzing the Job; Determining Objectives; Preparing to Train; How to do OJT; and Pre- and Post-training Evaluation. The book will help the supervisor to analyze the job, prepare himself and the employee, proceed through the steps, and provide follow-up.

Cenci, Louis. *Skill Training for the Job,* Pitman Publishing Corp., New York, 1966.

Chenzoff, Andrew P. and Folley, John D., Jr. *Guidelines for Training Situation Analysis (TSA),* Technical Report NAVTRADEVCEN 1218-4, Prepared by Applied Science Associates, Inc., Valencia, Pa., for U. S. Naval Training Device Center, Port Washington, New York, July 1965.

These guidelines represent a textbook for instruction in three phases of Training Situation Analysis (TSA), a standardized procedure, developed by NTDC, for systematically gathering and interpreting the information that is relevant to the planning of training and training devices.

Three phases of TSA are described in detail: System Familiarization, Task Analysis Method (TAM) and Training Analysis Procedure (TAP). System Familiarization provides an orientation to the training problem, the system structure and flow, and the equipment. Task Analysis Method produces a set of task descriptions containing the information necessary for making training device decisions. Training Analysis Procedure produces a ranking of tasks based upon the potential benefit to system performance as a result of training and the cost of that training. Recommendations for the conduct of these three phases and suggested working forms are presented.--*Auth.*

Craig, R. L. and Bittel, L. R. (ed.). *Training and Development handbook,* McGraw-Hill, New York, 1967.

Department of Employment and Productivity. *The Training and Use of Operators as Instructors,* Her Majesty's Stationery Office, London, 1969.

Folley, John D., Jr., Joyce, Reid P., Mallory, William J. (Applied Science Associates, Inc.), and Thomas, Donald L. (Air Force Human Resources Laboratory). *Fully Proceduralized Job Performance Aids: Volume I-Draft Specification for Organizational Maintenance,* Technical Report AFHRL-TR-71-53, Volume I, Air Force Human Resources Laboratory, Wright-Patterson AFB, Ohio, December 1971. AD-704 903.

This report supplies a model for specifications for the preparation of Fully Proceduralized Job Performance Aids for the operational maintenance of Air Force man-machine system. The model reflects the research findings of AFHRL and other DOD agencies concerning maintenance data. It has the unique feature of requiring that certain subproducts necessary for the development of this type of data be prepared in a standard format and submitted for review by the procuring agency. These subproducts include items such as a task identification matrix, task inventory, a task description index and management matrix, and task step data details. The aids to be developed from these specifications are for the *organizational* maintenance of any man-machine system and support the performance of the following maintenance functions: Checkout, alignment, repair, adjustment, calibration, malfunction isolation, and the removal and replacement of malfunctioning equipment items. It calls for the preparation of the aids in several options of job guide format.--*Auth.*

Folley, John D., Jr., Joyce, Reid P., Mallory, William J. (Applied Science Associates, Inc.), and Thomas, Donald L. (Air Force Human Resources Laboratory). *Fully Proceduralized Job Performance Aids. Volume II--Developer's Handbook,* Technical Report AFHRL-TR-71-53, Volume II, Air Force Human Resources Laboratory, Brooks, AFB, Texas, December 1971. AD-744 007.

This report provides guidance for the development of fully proceduralized job performance aids for the organizational maintenance of Air Force man-machine systems. It contains detailed instructions for preparing fully proceduralized job performance aids in accordance with the requirements of the draft specification contained in AFHRL-TR-71-53(I). It includes instructions for performing the behavioral task analysis and for converting the results of the analysis into effective performance aids. In addition, it presents a strategy and guidance for developing supervised practice exercises designed to produce the skills required to prepare fully proceduralized job performance aids.--*Auth.*

Gropper, G. L. *A Technology for Developing Instructional Materials,* Vol.1. *User's Manual;* Vol. 2. *Orientation,* Vol. 3. *Handbook;* Vol. 5. *Final Exercises,* American Institutes for Research, Pittsburgh, September 1971.

Haggard, Donald F., Willard, Norman, Jr., Baker, Robert A., Osborn, William C., and Schwartz, Shepard. *An Experimental Program of Instruction on the Management of Training,* Technical Report 70-9, Human Resources Research Organization, HumRRO Division No. 2, Fort Knox, Kentucky, June 1970 (AD 711 948)

A 96-hour course on the management of training was developed and evaluated for presentation to advanced officer classes. The general procedures followed in developing the course were construction based on job task statements, a systems-engineering approach to training, and state-of-the-art technology; repeated presentation of course materials, and modification by training research personnel on the basis of student and instructor appraisals. The course was then presented and evaluated by a military instructor. Critiques by military students and staff indicated that the course had considerable value, but required some additional revision before adoption by the Army. Suggested revisions were: (a) reducing course length, (b) integrating the course and CONARC Regulation 350-100-1, (c) coordinating supporting literature and course objectives, and (d) implementing the revised course as a common subject in officer training programs. These revisions would not require further research and development and could be accomplished by military operational training personnel with technical advice by research personnel.

Hummel, Lester F. and Newmaster, Ronald D. *Computerized Preparation of Navy Training Manuals,* Report 95, Operations Analysis Department, Navy Fleet Material Support Office, Mechanicsburg, Pa., 17 January 1973. (AD 754 431)

Navy training manuals require continuing revision in order to remain current. Considerable time and man-effort are required to accomplish the revision of such manuals. The use of a computer assisted document preparation system in the update of these manuals offers potential for significant reductions in both the elapsed time and the man-effort required to complete a revision cycle. This report relates the results of a pilot project initiated to test the feasibility of using such a computer-based text-editing system to update Navy training manuals. The Computerized Specification Management System (CSMS), a text-editing system developed by Naval Electronics Laboratory Center (NELC), San Diego, California, was used to prepare revised editions of two Navy training manuals and their associated correspondence courses. Modification and enhancement of the original system was required to provide additional font and character capabilities. Significant reductions in elapsed time and man-effort required to update a manual were achieved. Additional texts will be assigned for update via the CSMS system and efforts to refine and improve the system will continue.

Jacobs, Paul I., Maier, Milton H., and Stolurow, Lawrence M. *A Guide to Evaluating Self-instructional Programs,* Holt, Rinehart & Winston, 1966.

Joyce, Reid P., Folley, John D., Jr., and Elliott, Thomas K. (Applied Science Associates, Inc.). *Fully Proceduralized Job Performance Aids. Volume III--JPA Manager's Handbook,* Technical Report AFHRL-TR-71-53, Volume III, Air Force Human Resources Laboratory, Brooks AFB, Texas, December 1971. AD-744 817.

This report provides guidance for the Air Force data managers charged with the responsibility for the procurement of fully proceduralized JPAs. It provides guidelines, suggested procedures, and checklists for use by data managers in the review and assessment of the subproducts, intermediate products and JPAs produced in accordance with the draft specification contained in AFHRL-TR-71-53(I).

Mager, Robert F. and Beach, Kenneth M., Jr. *Developing Vocational Instruction,* Fearon Publishers, Belmont, Calif., 1967.

Developing Vocational Instruction describes the steps involved in preparing instruction that can be demonstrated to facilitate learning. In so doing, the concern is not with what would be the easiest thing to do, but what will be the most professional. Probably better than anyone else, vocational and technical instructors realize that there can be just as big a difference between practicing a skill and teaching it as there is between teaching and telling. The goal of this book is to describe the steps that must be carried out if one is to become as expert in the skill of systematic course development as he is in the practice of his own vocation or technical specialty.

The procedure of systematic course development outlined in this book is not specific to subject matter or vocation, and it applies to many academic as well as vocational and technical areas.--*Auth.*

Margolis, Fredrick H. *Training by Objectives: A Participant-oriented Approach,* Behavioral Science Center of Sterling Institute, Washington, D. C., June 1970.

Miller, R. B. *Handbook on Training and Training Equipment,* Technical Report WADC-TR-53-136, Aero Medical Laboratory, Wright Air Development Center, Wright-Patterson AFB, Ohio, June 1953. (AD 16 859)

This *Handbook* is intended to aid in preparing recommendations on the design and use of training equipment. As such, it permits cross referencing to a companion report, WADC Technical Report 53-138, *Human Engineering Design Schedule for Training Equipment.* The contents of the *Handbook* include learning and transfer theory, principles applicable to problems of training, and bibliographic references. One principal theme that is developed is that different kinds of tasks, and different degrees of learning have different implications for transfer of training and the best form of presenting knowledge of results. Stages of learning are analyzed in detail, as are the variables in "knowledge of results." The principal sections are titled: I. Human Learning as An Overview; II. The Role of the Instructor in Training; III. The Trainer as a Demonstrator of Principles; IV. The Use of Knowledge of Results; V. The Problem of Simulation; VI. The Problem of Motivation; VII. Preparing the Specifications for a Training Device. The many problems indicated as requiring further research in the field of human learning and training suggest the importance of "programmatic" studies. These materials, in conjunction with WADC TR 53-137, *A Method for Man-Machine Task Analysis,* and WADS TR 53-135, *A Method for Determining Human Engineering Design Requirements for Training Equipment,* are designed for use by trained personnel.--*Auth.*

McGehee, W. and Thayer, P. W. *Training in Business and Industry,* John Wiley and Sons, New York, 1961.

Here is a book that places training in perspective as a mangement tool for achieving organizational goals in business and industry. Instead of merely surveying available training techniques, it critically examines them on the basis of recent research and actual business and industrial experience. The aim of the book is to develop a sound rationale for analyzing and solving the training problems encountered in practice.

All four basic elements involved in the development of a training program are considered in detail: determining training needs; utilizing data drawn from the psychology of learning; selecting appropriate techniques; and assessing training results. Careful consideration is also given to the allocation of responsibility for training in industry. Emphasis throughout is placed on harmonizing training programs with clearly defined goals and on using learning theory and research as bases for choosing training procedures. Particular attention is given to such important recent developments as teaching machines, business games, and sensitivity training. An extensive bibliography is included.--*Auth.*

National University Extension Association. *Educational Technology*, prepared by National University Extension Association, Silver Spring, Md. (under a grant from the U. S. Office of Education), June 1968.

Ofiesh, G. D. *Programed Instruction: A Guide for Management*, American Management Association, New York, 1965.

Training is a costly business. Some have estimated its cost to industry alone as $30 billion annually. But all too often it is wasted...ill-conceived, and poorly managed.

The past few years have witnessed a sharp increase in industry's use of programed instruction to correct this inefficiency. Its effectiveness as a training technique has been proved in factories and offices across the nation...its value as a management tool has fast become an accepted fact. This book analyzes the emergence of programed instruction, explains the benefits of a programed-instruction-based training system, and discusses its applications to many industrial training problems.

This report contains case histories that show how this new training technique is being used in General Electric Company, International Business Machines Corporation, Trans World Airways, American Telephone and Telegraph Company, Burroughs Corporation, Liberty Mutual Insurance Company, Pfizer Laboratories, and numerous other industries, associations, and educational institutions. These examples clearly demonstrate the potential of programed instruction and point the way to new and greater training achievements.--*Auth.*

Parker, J. F., Jr. and Downs, J. E. *Selection of Training Media*, Technical Report ASD-TR-61-473, Behavioral Sciences Laboratory, Aerospace Medical Laboratory, Aeronautical Systems Division, Wright-Patterson AFB, Ohio, September 1961. (AD 271-483)

The selection of training media in support of military training programs represents an important area of concern. Training equipment exercises considerable influence on the way in which training programs are conducted, upon their effectiveness in accomplishing objectives, and upon the total cost of the program.

This report is designed to assist a training analyst faced with the problem of selecting specific training aids and devices to be used in support of the development of the personnel subsystem of a military system. The translation of statements of desired personnel performance and capabilities, as presented in Qualitative and Quantitative Personnel Requirements Information and task analysis documents, into training objectives is discussed. The effectiveness of various training media in meeting specific training objectives is indicated and justified in terms of available objective evidence. An example is presented illustrating the manner in which training media are selected in support of a typical Air Force operator position.--*Auth.*

Popham, W. J. and Baker, E. L. *Establishing Instructional Goals*, Prentice-Hall, Englewood Cliffs, N. J., 1970.

This book consists of a collection of five self-instruction programs designed to be completed individually by the reader. The programs deal with various aspects of instruction and are intended to provide a set of tangible competencies that can be employed by a teacher in making instructional decisions. The focus of the programs in this volume is on the topic of instructional goals: how to select them, how to state them, and how to establish pupil performance standards for such goals. After completing the five programs, you will be skilled in dealing with questions related to educational objectives. The competencies provided by the programs should be of considerable value to individuals who are preparing for a teaching career at any level of instruction, kindergarten through college. Experienced teachers will also find that the topics treated in the programs bear upon many practical decisions that they must make regarding their instruction. In essence, then, both preservice and inservice teachers should profit from completing the programs contained herein.--*Auth.*

Rundquist, Edward A. "Extension, Facilitation, and Validation of a Course Design procedure and its Basic Concepts," (Project No. F39522, Work Unit-0162), Naval Personnel and Training Research Laboratory, San Diego, Calif. (In preparation, June 1971).

In general, training courses are not designed to be so effective and efficient as they could be. Previously an integrated procedure for the design and improvement of school training courses was developed. When the procedure is applied under professional guidance, marked gains in training occur. Certain of the steps, notably the task analysis, have been found very difficult for typical Navy instructors to apply. It is one of the purposes of this work unit to discuss ways of simplifying the application of such steps. Two additional purposes are to: (1) determine whether the procedure can be extended to more complex duty assignments and to shipboard training; and (2) validate further selected course design and training concepts basic to the application of the procedure.--*Auth.*

Rundquist, Edward A. *Job Training Course Design and Improvement* (2nd ed.), Research Report SRR 71-4, Naval Personnel and Training Research Laboratory, San Diego, Calif., September 1970. (AD 876 204)

The second edition of the course design manual is a thorough revision of earlier editions. The manual is designed to assist instructors in developing and improving job-related training courses. Major changes from earlier editions include more careful definitions of training and training related terms; a general clarification of concepts and procedures, especially those concerned with job and skill analysis for training purposes; more emphasis on principles of developing training exercises; a more thorough consideration of the importance and means of adapting individual differences; and more emphasis on the significance of the course mission for course design. Examples from a wide variety of duty assignments are included.--*Auth.*

Smith, Robert G., Jr. *Controlling the Quality of Training*, Technical Report 65-6, The George Washington University, Human Resources Research Office, Alexandria, Va., June 1965. (AD 618 737)

The need for a quality control system in a military training program and methods of establishing such a unit are described and evaluated in this report, which is part of a research project in the technology for developing training. It is stated that the purpose of quality control is to ensure a satisfactory standard of competence among the students who graduate, to maintain this quality by a continuous monitoring process, and to improve training where it is found to be deficient. In order to function successfully, a quality control system should constitute a separate unit, independent of, but cooperating with, the instructional departments. Attention is given to proficiency testing as the chief means of measuring the success of the training program, with emphasis upon the importance of a uniform standard and consistent method in the preparation, administration, and scoring of tests.--*Auth.*

Smith, Robert G., Jr. *The Design of Instructional Systems*, Technical Report 66-18, The George Washington University, Human Resources Research Office, Alexandria, Va., November 1966.

This report, based on an extensive survey of current literature, describes a system approach to designing training and considers factors bearing on training effectiveness. An efficient instructional system is conceived as one in which the components form an integrated whole, achieving maximum effectiveness at the least possible cost. Components considered in this report include presentation media, student management, techniques for practicing knowledge and performance, knowledge of results, directing student activities toward the goals of the training program, and testing and evaluating the system in terms of efficiency and cost.--*Auth.*

Smith, Robert G., Jr. *The Development of Training Objectives*, Research Bulletin 11, The George Washington University, Human Resources Research Office, Alexandria, Va., June 1964.

This bulletin describes modern concepts and techniques used in determining training objectives. A training objective is a precise clear statement of one of the performances expected of a student upon completion of a course, a complete list of such objectives constituting the mission of a course. The concepts and techniques described are based on research performed by both military and civilian researchers in the field of training.

The development of job-related, detailed statements of objectives is a matter of the first importance in designing effective training programs. These objectives permit every element of a training program--lessons, texts, practical exercises, and examinations--to fall into line in a consistent manner. Training objectives that are job relevant will provide for a course that will also be responsive to the needs of the unit to which the soldier will go after training, and that includes little irrelevant content.

The techniques described have been selected as being practical for Army training personnel. Those who wish to learn more of the theory and techniques of determining objectives will find a selected bibliography listed by chapter at the end of the bulletin. The rationales for the various aspects of developing objectives will be presented, and appropriate choices of techniques indicated.--*Auth.*

Smith, Robert G., Jr. *The Engineering of Educational and Training Systems*, D. C. Heath and Co., Lexington, Mass., 1971.

In writing this book on the engineering of education and training systems, I have tried to explain the implications of systems ideas for education and training and to provide sufficient descriptions of suitable methods and techniques, so that either with this book alone, or in a few cases, by reference to cited works of others, the reader could design and implement effective systems.

I have resisted the temptation to be highly critical of modern practices in education and training. Where critical comment is made, it has been inserted primarily to clarify an example. Following the same theme, the final chapter presents a series of positive suggestions for dealing with what is obviously a current educational crisis of major dimensions. --*Auth.*

Stokes, P. M. *Total Job Training: A Manual for the Working Manager*, American Management Association, New York, 1966.

Training Psychology Branch, Behavioral Sciences Laboratory, Aerospace Medical Laboratory. *Uses of Task Analysis in Deriving Training and Training Equipment Requirements,* Technical Report WADD-TR-60-593, Wright Air Development Division, Air Research and Development Command, Wright-Patterson AFB, Ohio, December 1960.

The requirements for and uses of task information in developing requirements for training equipment are discussed in a series of seven papers by the human factors subcontractors involved in the development of three complex electronic reconnaissance systems. The papers deal with the purposes, content, sources, and recording of task information. They cover the uses of task analysis information in establishing training requirements, selecting training equipment, and developing proficiency measures. A final paper describes in detail the approach taken on these issues with the AN/ULD-1 system.--*Auth.*

U. S. Civil Service Commission, Bureau of Training. *Training Evaluation: A guide to its Planning, Development, and Use in Agency Training Courses,* Training Systems and Technology Series No. 4, Pamphlet T-13, U. S. Government Printing Office, Washington, D. C., May 1971.

U. S. Department of Health, Education, and Welfare, Office of Education, Bureau of Adult, Vocational, and Technical Education. *Motivation and the Disadvantaged Trainee: A Manual for Instructors,* (OE 37068) U. S. Government Printing Office, Washington, D. C., 1970.

U. S. Department of Labor, Manpower Administration, *A Handbook for Upgrading Low-Skilled Workers,* Research and Demonstration Findings No. 13, prepared by Humanic Designs Corporation, for U. S. Department of Labor, U. S. Government Printing Office, Washington, D. C., 1971.

This handbook for upgrading low-skill workers attempts to synthesize the experience and findings of more than four years of research and demonstration work in upgrading under-employed workers in the plant environment. It contains procedural and methodological guidelines for individuals and organizations that are undertaking in-plant programs to upgrade low-skill workers to higher levels of work and productivity. The guidelines are not intended to be job or program specific, but rather apply to a wide range of industry conditions and problems for which in-plant upgrading programs provide at least a partial solution. --*Auth.*

U. S. Department of Labor, Manpower Administration. *Toward the Ideal Journeyman Volume 2. The Training System in the Pipe Trades,* Manpower Research Monograph No. 20, U. S. Government Printing Office, Washington, D. C., 1971.

U. S. Department of Labor, Manpower Administration. *Toward the Ideal Journeyman. Volume 3. Apprenticeship Training in the Machinist and Tool and Die Maker Trades,* Manpower Research Monograph No. 20, U. S. Government Printing Office, Washington, D. C., 1971.

U. S. Department of Labor, Manpower Administration. *Toward the Ideal Journeyman. Volume 4. The Training System in the Printing Trades,* Manpower Research Monograph No. 20, Manpower Administration, Washington, D. C., 1971.

U. S. Department of the Navy, Bureau of Naval Personnel. *All Hands* (Nav-Pers-O), Number 611, Washington, D. C., December 1967.

Warmbrod, J. Robert. *Review and Synthesis of Research on the Economics of Vocational Education,* Information Series, The Center for Vocational and Technical Education, ERIC Clearinghouse on Vocational and Technical Education, The Ohio State University, Columbus, Ohio, November 1968. (ED 023 937)

Warren, M. W. *Training for Results: A systems Apporach to the Development of Human Resources in Industry,* Addison-Wesley, Reading, M, Mass., 1969.

Weisgerber, Robert A. (ed.) *Instructional Process and Media Innovation,* Rand-McNally, Chicago, 1968.

Willis, M. Paul and Peterson, Richard O. (American Institutes for Research). *Deriving Training Device Implications From Learning Theory Principles. Volume I: Guidelines for Training Device Design, Development and Use,* Technical Report NAVTRADEVCEN 784-1, U. S. Naval Training Device Center, Port Washington, New York, July 1961.

SECTION V

TRAINING COST-EFFECTIVENESS LITERATURE

From a classical, economical point of view (e.g., Mincer, 1962; Becker, 1962; and Canby, 1972), vocational training is an investment by the person as well as the organization. A number of mathematical formulas and several strategies for optimizing one's return on such investments have been developed (e.g., Bateman, 1966). Most of these formulas, complicated as they may be, are woefully inadequate for two reasons. They are almost never based upon data; and they do not consider all the factors that need to be considered.

There is general agreement, for example, that the following factors should be considered in cost-effectiveness algorithms about OJT: (a) the possibility of selectively recruiting people in certain fields as an alternative to training inexperienced civilians (Hanushek, 1971; Kim, Lieser, Scheirer, and Minckler, 1968); (b) the differential relationship of OJT and resident school training to unit readiness (O'Flaherty and O'Rorke, 1967); (c) the impact of the value of military training in civilian careers upon leaving the service (McCall and Wallace, 1967); (d) the impact of the military organization's reputation for training upon the enlistment rate (Lochman, Stoloff, and Allbritton, 1972; and Katz, 1971); and (e) the cost of training failures (Sands, 1971). These factors (which are not all listed, but indicative of the problem) are not considered in any one mathematical model reviewed. In fact, it is difficult to find a mathematical model that considers any two of them.

Even if such factors could be adequately considered in a quantitative formula of some kind, it is extremely difficult to quantify all the costs associated with operating an OJT program. The Army, Navy, and Air Force have made some laudable efforts to do this (Arzigian, 1967; Clary, 1970; Gay, 1973; Kollin, 1966; and Strope, 1967), but no military analyst has really been satisfied that he has accomplished what he set out to do.

Cost-effectiveness studies of OJT are complicated by the fact that the OJT costs, *per se*, do not really provide enough information to make decisions. It is the *relative* costs of various options (e.g., Plan A versus Plan B) that need to be determined before people can make the types of decisions that need to be made.

One of the most important relative cost decisions is that about the mix of OJT and resident school training. Because the problem is such an important one (millions of dollars are involved), and because the information is urgently needed (military training loads have fluctuated widely in recent years), the most sophisticated work on cost-effectiveness of OJT has been done in this area (Bateman, 1966;

Black and Bottenberg, 1970; Gay, 1973; Lecznar, 1972; Weiher and Horowitz, 1971A, 1971B; Weinberg, 1967; Dunham, 1972; and Walker, 1965). The results, however, are somewhat contradictory. One recent Navy study suggests that OJT is more expensive than resident school training because of all the supervisory time spent with OJT trainees (Weiher and Horowitz, 1971B).

An equally recent Air Force study finds that the resident school training in Category B specialties is about twice as expensive as OJT, while the difference between graduates is negligible (Dunham, 1972). Neither of these studies claims to have considered all the factors that should be considered in a cost-effectiveness study--a situation that is typical of work in this area--so the inconsistency can be explained in a variety of ways.

One of the reasons that training cost-effectiveness studies tend to be oversimplified is that the people performing the studies are not training experts. A more complete list of variables is provided by Walker (1965), who asked 20 training and human engineering personnel to develop their own criteria. The list of effectiveness variables that they mentioned is sizeable and much more numerous than the mathematically oriented cost-effectiveness studies reviewed in this report (Table V-1).

TABLE V-1

Selection Criteria for Training[a]

	Selection Criteria[b]	Percentage of Technical Training Personnel Who Mentioned These Criteria
1.	*Time to produce*	100
2.	*No. of students taught*	83
3.	*Effectiveness of teaching motor skills*	75
4.	*Effectiveness of teaching theory*	75
5.	*Amount of data needed to prepare*	75
6.	*Cost to teach*	75
7.	*Cost to develop*	75
8.	*Facilities needed to present*	67
9.	*Specific objectives*	67
10.	*Level of student intelligence*	58
11.	*Student knowledge*	58
12.	Student Motivation	33
13.	*Quality of specialists to develop material*	33
14.	*Ease of evaluating students*	25
15.	*Facilities needed to prepare*	25
16.	*Ease of administration*	17
17.	*Complexity of the training material*	17
18.	*Flexibility*	17
19.	*No. of instructors to instruct*	17
20.	*No. of instructors to develop*	17
21.	Student Reinforcement	17
22.	Student Participation	17
23.	Realism[c]	8
24.	Transfer of Training[c]	8
25.	*Maneuverability*	8
26.	Variety of psychological/learning processes	8
27.	Student feedback	0
28.	Retention	0
29.	Student paced	0
30.	No. of senses stimulated	0
31.	*Length of course*	0
32.	Stimulation of the operational environment[c]	0
33.	*Ease of presentation*	0
34.	Competition	0

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[a] From Walker, Ralph W. (1965).

[b] Items in italics are management-centered items; others are student-centered items.

[c] Equally student- and management-centered items.

REFERENCES

The references that are listed here have been cited in this section; when author abstracts were available, they are given.

Arzigian, Simon. *On-the-Job Training Costs*, an Analysis Research Memorandum WRM 67-52, Personnel Research Laboratory, Naval Personnel Program Support Activity, Washington, D.C., June 1967. (AD 656 581)

This study presents the results of a preliminary investigation of the feasibility of computing on-the-job training costs. For purpose of this study, on-the-job training is that which involves learning or improving job performance under actual working conditions. At present, there is no system within the Navy to "cost out" on-the-job training. Training-cost reporting is limited to formal, or school training. The addition of an on-the-job training cost to the school cost (if any) would provide a more "complete" training cost. Training costs play a major part in many personnel management decisions; therefore, a training cost that reflects all the training that is provided an individual would prove valuable.--*Auth.*

Bateman, C.W. (Office of the Secretary of Defense). "Formal and On-the-Job Training in Military Occupations," in Jessop, W.N. (ed.). *Manpower Planning, Operational Research and Personnel Research: A NATO (Science Committee) Conference on Operational and Personnel Research in the Management of Manpower Systems* (held in Brussels, 17-20 August 1965), American Elsevier Publishing Company, New York, 1966, pp. 183-198. (ED 017 799)

A model is constructed to determine the best proportion of formal and on-the-job training in military occupations. Special consideration is given to the unique situation of enlisted personnel's fixed length of service, the small percentage of reenlistment, and the necessity of training all enlistees for assigned occupations. The model formula represents training requirements, semiskilled and skilled levels, amount of time spent at each skill level (determined by formal, or on-the-job training), and cost reduction possible without reduction of the level of effectiveness. Analysis is applied to ten Air Force occupations including cook, automotive repairman, electrician, and personnel and administrative specialists. Results are shown in six tables. Costs are generally lower for on-the-job training, but enlistees remain at the semiskilled level longer than formally trained enlistees.--*Auth.*

Becker, Gary S. "Investment in Human Capital: A Theoretical Analysis," *Journal of Political Economy*, Vol. 40, No. 5 (Pt. 2, Suppl.), 1962, pp. 9-49.

Black, Doris and Bottenberg, Robert A. *Comparison of Technical School and On-the-Job Training as Methods of Skill Upgrading*, Technical Report AFHRL-TR-70-48, Personnel Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, December 1970. (AD 726 530)

In the Air Force, basic technical skills classified as Category B skills are those in which a portion of the total personnel requirement is formally trained in a technical training course and the remainder is trained on the job (OJT). Determination of the relative numbers of airmen to be trained in formal courses and in on-the-job training is based, in part, upon the time required to qualify a specialist at the five-skill, or fully qualified level. This report provides information on rates of progression to the five-skill level in Category B skills by comparing samples of technical school and on-the-job training personnel. Development of the methodology used to measure the rates of progression to the five-skill level was described, along with an explanation of the achievement ratio defined in this study. Achievement rates from basic military training (BMT) graduation to award of the five-skill level were investigated. In the majority of the Category B specialties, there was inconclusive evidence of any advantage for technical training over OJT. In the specialties in which there were substantial differences between the two groups, the differences in most cases favored technical training. There were two specialties in which neither training group was superior to the other. The achievement rates after award of the three-skill level (i.e., apprentice level) to award of the five-skill level were not entirely consistent with achievement rates from BMT graduation to the five-skill level. In many cases, it was found that OJT personnel progressed more rapidly than technical school personnel from the three-skill to the five-skill level.--*Auth.*

Canby, Steven L. *Military Manpower Procurement: A Policy Analysis*, Lexington Books, D. C. Heath and Company, Lexington, Mass., 1972.

Since 1965, when large numbers of American troops began to arrive in Vietnam, the draft has become a major public policy issue that has generated considerable literature. Most of these publications are: (1) analyses of the operation of the Selective Service System, (2) cost estimates of a proposed volunteer military force, or (3) polemics for a particular recruitment system.

This study attempts to take an impartial and comprehensive look at the entire military recruitment issue. It asks: What are the attributes desired in a military recruitment system for the United States? It lists 17 criteria for assessing the relative merits of alternative recruitment systems.--*Auth.*

Clary, James N. *Training Time and Costs for Navy Ratings and NECs*, WOS 71-1, Naval Personnel Research and Development Laboratory, Personnel Systems Research Department, Washington Naval Yard, Washington, D.C., July 1970. (AD 711 315)

Reports FY 69 data on enlisted training time and costs to be used as inputs to the Career Premium Computer Program for determining Pro Pay eligibility. Specifically, it presents the training time and funds invested in enlisted personnel from initial procurement through appropriate basic training for 80 general and service ratings and advanced and specialized training for 1,067 Navy Enlisted Classifications (NECs) by source ratings.--*Auth.*

Dunham, Alan D. *Estimated Cost of On-the-Job Training to the 3-Skill Level in the Communications Center Operations Specialty*, Technical Report AFHRL-TR-72-56, Personnel Research Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, June 1972. AD-753 093.

Decisions concerned with the use of alternative Air Force training methods require several types of data. Among these are capacity to train, cost of the training, and quality of the trained airmen. The two methods of formal training in the Air Force are on-the-job training (OJT) and technical school training. The data currently being provided to decision makers for selecting the proper mix of these two training methods can be substantially improved.--*Auth.*

Gay, Robert. "The Cost of On-the-Job Training in Military Occupations," R-1351-ARPA, prepared for the Advanced Research Projects Agency under Project No. 9303, Rand, Santa Monica, Calif., April 1974.

This Report is part of Rand's DOD Manpower and Training Management Program, sponsored by the Human Resources Research Office of the Defense Advanced Research Projects Agency (ARPA). The purpose of this research program is to bring new methodologies to bear on present and future military manpower problems. The purpose of this report is to provide a way of estimating the costs and determinants of on-the-job training in military occupations. As such, this study is only a pilot effort, meant to find a feasible technique for estimating these implicit--but none the less real-costs faced by the Department of Defense. The results from this pilot effort suggest that on-the-job training costs are more than twice as much as technical schooling costs for the occupation examined, aircraft maintenance in the Air Force. Thus, further study of these costs across occupations and services is warranted. In addition, this study is the first to estimate the relationship between individual characteristics and individual on-the-job training costs. Such information, if validated by further study, may prove valuable to the military services with respect to selection, assignment, and pay policies.--*Auth.*

Hanushek, Eric A. *Training in the Air Force—The Example of Graduate Education,* Research Report 71-3, U.S. Air Force Academy, Colorado, April 1971.

This paper applies models for rational investing in human capital to Air Force decisions on training and particularly decisions about graduate education for officers. Two separate questions are addressed in depth. First, among the possible types of officers (rated-nonrated, reserve-regular, by length of service) who could be sent to school, are there any economic advantages to a specific group? In terms of the possibilities for the investment paying off (i.e., recouping the costs of training) the decision rules are unambiguous: nonrated are a better investment than rated, and the more junior officer is a better investment than the more senior. Further, there is some reason to favor reserve officers rather than regular officers, since their retention is lower and lower retention in this case is desirable in terms of the total costs per year of educated service. Second, what is the trade-off between educating Air Force officers and hiring people who have purchased their own education? Here it appears much more expensive to educate Air Force officers; the long-run total cost differential between no internal education and all internal education is on the order of $100 million per year. While there are some compelling reasons to do some educating, serious consideration should be given to the question of how much educating the Air Force should sponsor.--*Auth.*

Katz, Aaron. *Personnel Reactions to Incentives, Naval Conditions and Experiences (PRINCE): Demographic and Background Information, Expectations, Attitudes, Values and Motivations of New Recruits,* WRR 72-2, Naval Personnel Research and Development Laboratory, Washington Navy Yard, Washington, D.C., September 1971.

As part of a longitudinal study of the reactions of enlisted men to personnel incentives, Naval conditions and experiences, information on backgrounds, expectations, attitudes, values, and motivations were obtained at entry into the Navy from 6,795 recruits in Categories I, II, and III on AFQT.

New recruits see the Navy more frequently as an environment in which they can satisfy some short term goal. Some of the most important reasons for joining the Navy were: to get technical training, needing time to find out what they wanted to do with their lives, and not wanting to wait until they were drafted.

On the basis of a comparison of: (1) their educational achievement to date with that of their parents, and (2) their occupational goals with the current occupations of their fathers, it appears that many recruits are interested in upward social mobility.--*Auth.*

Kim, Kwan H., Lieser, Tom K., Scheirer, William K., and Minckler, Rex. *An Army 75 Personnel Procurement Concept for the Department of the Army, Volume I: The Study Report*, Battelle Memorial Institute, Washington, D.C., 31 July 1968.

Kollin, George. *Phase I--An Examination of Costs and Recording Practices at CONARC Service Schools*, Technical Paper RAC-TP-204, Research Analysis Corporation, McLean, Virginia, May 1966.

The need for a study of training costs has often been expressed by Army personnel. Such a study would be of help to managers of planning and programming of training especially when significant changes occur in the size and composition of force requirements and weapon systems.

The two major areas of formal school training are the service schools and the training centers. Other large training areas are nonschool, such as on-the-job training and basic combat training.

This study examines several service schools with respect to their training-cost recording practices, the degree of uniformity from school to school, and the cost elements that are considered. In addition to determining what is occurring at the service schools, an attempt is made to indicate other cost factors related to training, but not now included by the schools.

As a research strategy, courses for three hard-core military operational specialties (MOSs) were chosen so that through the study of these individual courses the above objectives could be achieved more easily.

To lend realism to the study, dollar costs for training these three skills have been included, but only to point up the complexities involved in a future attempt to arrive at complete, accurate training costs and a training-cost information system.--*Auth.*

Lecznar, William B. *The Road to Work: Technical School Training or Directed Duty Assignment?* AFHRL-TR-72-29, Personnel Research Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, April 1972. AD-754 845.

This study explored the question of differences between airmen who were assigned to jobs following graduation from formal resident training schools and those who entered a field as on-the-job trainees. Eight career fields with a substantial number of airman input of low-ability personnel under Project 100,000 were studied. Evaluations of technical school graduates and directed duty assignees were made in terms of six criteria: a job difficulty index, average task difficulty, number of tasks performed, job interest, self-report of utilization of talent and training, and overall performance rating with type of membership categories (i.e., resident technical course or direct assignment) and with aptitude held constant, tests of the significance in difference between regression lines were made. In nearly every instance, the results indicated that the intercepts and slopes of the lines for the two groups were the same. That is, technical school graduates and directed duty assignees were not different on any of the six criterion comparisons. This is not to suggest, however, that formal school training can be wholly displaced by on-the-job training.--*Auth.*

Lockman, Robert F., Stoloff, Peter H., and Allbritton, A. Slagle. *Motivational Factors in Accession and Retention Behavior*, Research Contribution 201, Center for Naval Analyses, Institute of Naval Studies, Arlington, Va., January 1972.

Motivational factors in accession and retention behavior of Navy men were identified in a reanalysis of past surveys. Economic, psychological, and personal history variables were found to be of joint importance in predicting enlistment and reenlistment behavior. Better measurement of these kinds of variables should result in improved predictions and policy control mechanisms.--*Auth.*

Mincer, Jacob. "On-the-Job Training: Costs, Returns, and Some Implications," *Journal of Political Economy*, Vol. 70, No. 5 (Pt. 2, Suppl.), 1962, pp. 50-79.

McCall, John and Wallace, Neil. *Training and Retention of Air Force Airmen: An Economic Analysis*, Memorandum RM-5384-PR, prepared for U.S. Air Force Project RAND, The Rand Corporation, Santa Monica, Calif., August 1967.

This memorandum examines several aspects of the training and retention of Air Force electronic specialists. The major goal of the study is to investigate the responsiveness of the reenlistment rate to changes in Air Force remuneration. An attempt is also made to measure the degree to which Air Force training is transferable to the civilian economy.

O'Flaherty, John and O'Rorke, Richard J., Jr. *Costing a Unit Training Program: Volume I--General Systems Description*, Report RAC-R-23, Research Analysis Corporation, McLean, Va., April 1967. (AD 814 958L)

This report sets forth a methodology for ascertaining the direct variable costs incurred (parts and fuel consumption) through the usage of equipment in combat-unit training activities. Such costs are under current financial systems not readily available. Were such costs more readily available, through the adoption by the Army of a methodology such as described in the report, it is very possible that improvements could be effected in the usage of equipment, and the broad objective to which such usage is directed--combat-training readiness--could, in some degree, be enhanced. The report is presented in two parts: Volume I. General Systems Description; and Volume II. Derivation of Parts Cost Factors. The first volume describes the purpose of the investigation, the problems encountered, and the methodology developed--the latter in general terms. Specific recommendations are presented on continuing the development of the system described in order to achieve an operational system within the Army.

The second volume treats in detail the development of parts cost factors for 16 major items. The actual results are presented and analyzed and the computer programs are described. Problem areas are discussed and additional computer programs needed for improved accuracy and for theater, region, and unit factors (in addition to worldwide) are outlined.--*Auth.*

Sands, William A. *Application of the Cost of Attaining Personnel Requirements (CAPER) Model*, WTB 72-1, Naval Personnel Research and Development Laboratory, Washington Navy Yard, Washington, D.C., August 1971.

The CAPER Model appears to be a promising personnel system management tool. The output, numbers of men and dollar costs, is readily understood by everyone, unlike various statistical indexes popular among psychologists (e.g., validity coefficients). By requiring an explicit estimate of various types of costs, the model decreases the likelihood that policy decisions will be based upon implicit, unrecognized, and unwarranted assumptions. Finally, the model enables the personnel manager to readily adapt his recruiting-selection strategy to changes in quotas, costs, and/or alterations in the recruiting environment. The flexibility that the CAPER Model provides to the personnel manager is enhanced by the computer program.--*Auth.*

Strope, Donald H. "The Costs of Army Training," in Smith, R. Arthur and Allsbrook, Ogden O. (eds.), *The Utilization of Military Resources--A Department of the Army Cost Research Seminar on Operating Costs*, U.S. Government Printing Office, Washington, D.C., 1967, pp. 221-243. (AD 824 660)

The purpose of this paper is to present some results of Research Analysis Corporation research on Army individual training costs in order to discuss implications for future research and for Army action necessary to improve estimates of Army training costs. As is generally known, there is currently inadequate knowledge to determine the resource implications of training to establish various personnel skills.

It is important to know the context in which training costs will be used. The way costs are developed depends upon the type of problem for which the costs are used. Different problems require different levels of accuracy and different degrees of input detail. Training costs are used in each of the types of problems shown in Chart 1, but the amount of training cost detail varies with the type of problem.--*Auth.*

Walker, Ralph W. "An Evaluation of Training Methods and Their Characteristics," *Human Factors*, Vol. 7, No. 4, August 1965, pp. 347-354.

Sixteen training techniques were rated by experienced training personnel each with respect to 34 training selection criteria. Training personnel tend to narrow their selection criteria to those elements that are administratively and contractually imposed. Educational/psychological principles tend to be overlooked. Selection of training techniques in practice should be on a broader and more systematic basis if the selection is to be properly justified.--*Auth.*

Weiher, Rodney and Horowitz, Stanley A. *A Production Function for Trained Recruits*, CNA Professional Paper No. 84, Center for Naval Analyses, Arlington, Va., November 1971.

Weiher, Rodney and Horowitz, Stanley A. *The Relative Costs of Formal and On-the-Job Training for Navy Enlisted Occupations*, Professional Paper No. 83, Center for Naval Analyses, Arlington, Va., November 1971. (AD 734 857)

Weinberg, Gary. *Army Training Cost Study* (Draft report), Research Analysis Corporation, McLean, Va., July 1967.

The basic objective of the study was the development of a cost-estimating technique that can be used to estimate the cost of formal school training for military personnel. These estimates of formal school costs were generated for both individual MOSs and aggregated groups of manpower. The individual MOSs are those that involved formal school training in FY66.

The nine Department of Defense occupational areas were used as the framework for the aggregated model. Within each MOS and occupational area, three skill levels were utilized--junior, intermediate, and senior. These levels correspond to a defined mix of length of service, pay grade and MOS skill level.

Cost totals were derived for each Army budget appropriation and they represent the total dollars generated by formal school training during FY66. An allocation scheme was developed to obtain a per-man course cost. In addition, turnover rates for both the MOSs and occupational areas were formulated, enabling a cost analyst to determine a replacement training course cost.

A comparison was drawn between the MOS costs, occupational area costs and a per capita cost to show that, depending upon the level of aggregation used in any study, training costs may affect alternatives under consideration.--*Auth.*

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Selected cost-effectiveness documents, other than those cited in the text are given here.

Annett, J., Duncan, K. D. (Department of Psychology, University of Hull). "Task Analysis for Training," in Wilson, N.A.B. (ed.), *Manpower Research (Proceedings of NATO Conference, London, August 1967)*, English University Press Ltd., London, 1969, pp. 341-347.

Recent years have seen an increasing emphasis upon the need for statements of instructional objectives that are derived from job performance and that are in a sufficiently operational language so as to generate test situations, whereby instruction can be evaluated (e.g., Wallis, 1966). However, it is one thing to advocate training based upon task analysis, but quite another to indicate a general method of analyzing tasks for this purpose -- as the extent of the literature on task analysis testifies. If there is a weak link in the technology of training it is surely here.--*Auth.*

Benveniste, Guy. *The Economics of the New Educational Media*, International Institute for Educational Planning, Paris, February 1965. (This is a working document, it is circulated for comment only.)

When we speak of the "new media" we usually mean two kinds of teaching devices -- the mass media such as film, radio, and television used for instruction; and the new self-teaching devices such as programmed instruction and language laboratories.

This report explores the economics of instructional television, school radio broadcasting, films, and programmed instruction. Our objective is to provide a basis for determining the economic feasibility of using these new media in developing countries.

We have emphasized the economics of those educational media that can be used to provide a substantial portion of a given curriculum. The report does not cover the economics of audio-visual aids in general.

This research has recently been initiated at the Institute and is still underway. The purpose of this first or interim report is to bring up to date various individuals and institutions cooperating in this undertaking, and to obtain comments on the assumptions and methodology adopted and on the conclusions reached.

Bershtein, J. L. *Design of an Enlisted Personnel Cost Analysis System*, PRL Report No. WRM 67-11, Personnel Research Laboratory, Naval Personnel Support Activity, Washington, D. C., October 1966. (AD 643 965)

This memorandum provides in some detail the procedures and concepts of the enlisted personnel cost analysis system developed by the Personnel Research Laboratory. Sources of information and problem areas encountered during the course of research have also been indicated.--*Auth.*

Carpenter, M. B. *Maintaining Efficient Training Programs for Air Force Technical Specialties*, Report R-527-PR, The Rand Corporation, Santa Monica, Calif., September 1970.

This Report sets forth suggestions for research on ways to better maintain the efficiency of Air Force training programs, based on a study of Air Force policy and practice in this area. The study addresses the problem from two points of view: What should be the steps in the initial selection of subject matter and in the design of a training program, given that the job to be trained for already exists in a fairly stable form? and, How can the subject matter be kept current?--*Auth.*

Carpenter, Margaret B. and Haggart, Sue A. *Cost-Effectiveness Analysis for Educational Planning*, Paper P-4327, The Rand Corporation, Santa Monica, Calif., March 1970. (AD 704 778)

Champion, Joel T. and Ducharme, Richard E. *An Evaluation of the AFM 66-1 Manhour Reporting System*, SLSR-1-69, a thesis in partial fulfillment of the requirements for Master of Science degree, School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, August 1969. (AD 863 839)

AFM 66-1 Maintenance Management, provides a man-hour reporting system to aid maintenance managers in efficiently utilizing their manpower resources. However, this system became unpopular, and was made optional in 1965. An evaluation of its history indicated that it was a good system, but was misused and not fully understood by most maintenance managers. An analysis of labor force productivity since 1965 showed: (1) that actual productivity has not reached management's expectations, and (2) that the use of the Man-Hour Reporting System could improve labor force use. The study recommended that this system be made mandatory and that the past problems identified be avoided.--*Auth.*

Clary, James N. *Training Time and Costs for Navy Ratings and NECs*, WRM 68-13, Personnel Research Laboratory, Naval Personnel Program Support Activity, Washington, D. C., January 1968. (AD 667 578)

This memorandum reports Fiscal Year 1967 data on enlisted training time and costs to be used as inputs to the Career Premium Computer Program for determining Pro Pay eligibility. Specifically, it presents the training time and funds invested in enlisted personnel from initial procurement through appropriate basic Class "A" training for 79 general and/or service ratings, and advanced and/or specialized training for 707 Navy Enlisted Classification Codes.--*Auth.*

Clary, James N. *Training Time and Costs for Navy Ratings and NECs*, WSS 69-3, Naval Personnel Research and Development Laboratory, Washington, D. C., April 1969.

Reports FY 68 data on enlisted training time and costs to be used as inputs to the Career Premium Computer Program for determining Pro Pay eligibility. Specifically, it presents the training time and funds invested in enlisted personnel from initial procurement through appropriate basic training for 80 general and/or service ratings and advanced and/or specialized training for 888 Navy Enlisted Classifications (NECs).--*Auth.*

Clary, James N. *Training Time and Cost for Selected Ratings and NECs*, PRL Report No. WRM 67-20, Personnel Research Laboratory, Naval Personnel and Program Support Activity, Washington, D. C., December 1966. (AD 646 238)

Reports FY 66 data on enlisted training time and costs to be used as inputs to the Career Premium Computer Program for determining Pro Pay eligibility. Specifically, it presents the training time and funds invested in enlisted personnel from initial procurement through appropriate basic training for 28 ratings and advancement and/or specialized training for 171 Navy Enlisted Classification Codes.--*Auth.*

Dupuy, H. J. and Deimel, R. W. *Navy Recruitment Survey*, WRR 68-1, Personnel Research Laboratory Naval Personnel Program Support Activity, Washington, D. C., September 1967. (AD 663 564)

This report describes the results of a survey that was conducted to obtain information on the motivating influences affecting the decision to enlist or reenlist in the Navy.

Survey questionnaires were mailed to U. S. Navy recruiting stations throughout the country with the instruction that the recruiter in charge administer them during the week of 17-22 July 1967 to the first five enlistees or reenlistees (no females) immediately following their enlistment or reenlistment. Questions on this survey concerned specific motivations for enlisting or reenlisting in the Navy. A space was also provided for a write-in response if the main reason(s) for one's enlisting were not mentioned in the survey.

Findings reveal that "Opportunity to get technical training," "Desire to travel," "Desire to fulfill military obligation at own time of choice," and "Desire for a Navy career" were the most important personal reasons of the enlistees or reenlistees to enter the Navy. The influence of "Friends in service" and "Parents" were also important motivating forces.

The results provide the most important reasons and motivations for entering the Navy at the present time.--*Auth.*

Fortune, Jim C., Petry, John R., and Harding, Larry G. *Investigation of the Need for Motion in the Teaching of a Complex Motor Skill,* SRR 71-5, Naval Personnel and Training Research Laboratory, San Diego, Calif., August 1970.

This report describes a comparison of a medium that allows motion (video-tape) and one that doesn't (slide-tape) in the teaching of complex motor skills (lockwiring). Because of the differences in cost and in convenience of administration, it was deemed desirable to see if the video-tape produced significantly better results.

The results showed no significant differences in achievement, length of time to perform the tasks, clarity of presentation, or pacing of instruction. It was concluded that complex motor skills can be adequately taught by a slide-tape presentation that requires the student to perform the motor skills as the proper procedures are presented.

Garbutt, D. "The Costing and Evaluating of Training," in Barber, J. W., (ed.), *Industrial Training Handbook,* A. S. Barnes & Company, New York, 1969, p. 94-107.

Gettings, R. *Proposed Content of an Enlisted Personnel Cost Model,* PRL Report No. WRM 67-18, Personnel Research Laboratory, Naval Personnel Program Support Activity, Washington, D. C., December 1966. (AD 646 217)

This report presents an outline of a proposed enlisted personnel cost model. The need to develop such a computerized cost model has become evident with the increasing number of requests for cost data from a wide variety of Navy and Department of Defense offices.

The approach has involved an analysis of the present enlisted personnel cost system in terms of input, processing, and output. Revised outputs have been designed to provide concise reports of information frequently required. Modifications to the training cost reports are recommended as necessary to provide the revised outputs.--*Auth.*

Goldfarb, Robert S. *The Evaluation of Government Programs: The Case of New Haven's Manpower Training Activities,* Ph.D. Dissertation, Yale University, New Haven, Conn., 1968, 260 pp. (PB 182 173)

This thesis attempts to deal with difficult methodological problems of progress evaluation; the particular programs considered are two types of manpower training programs, institutional or "classroom" training and government-subsidized on-the-job training, as they operated in New Haven from 1964 to 1966.

Serious deficiencies of cost-benefit analysis are investigated, and the method is found to be inadequate for use in analyzing manpower programs. In particular, its tendency to ignore the existence of learning processes, which allows it to judge the potential of mature, experienced, efficient programs by studying new and inexperienced programs, is a critical weakness.

Since estimating "capacity for learning" or improvement is crucial for evaluating the potential of a program, methods of evaluation must be found which allow at least some of this capacity to be discovered. One way to do this is to study the way in which a particular process, such as a training program, turns inputs into outputs. Instead of ignoring the production process itself, as benefit-cost analysis tends to do, we must explore it.

Studying the production process leads to a shift in the types of results the research produces. Rather than trying to discover whether classroom training or on-the-job training as it was run in New Haven was a "worthwhile" investment (a question which we show that cost-benefit analysis actually fails to answer), we produce information that can contribute to the designing of better programs. Thus, the study itself becomes a part of the learning and maturing process that produces better programs.

Two data sources are used to study the production process. First, a group of trainees who underwent each type of training were interviewed. Second, employers who participated in the OJT program were interviewed, as were a group of the largest employers in the New Haven area.--*Auth.*

Glennan, Thomas K., Jr. *Evaluating Federal Manpower Programs: Notes and Observations*, RM-5743-OEO, prepared for Office of Economic Opportunity by The Rand Corporation, Santa Monica, Calif., September 1969, 55 pp. (ED 041 111)

Impact evaluations of manpower programs have had many shortcomings, especially in finding control groups for comparison. Methodological bias and inconsistency between evaluators, along with disinterest by program administrators, have prevented evaluation from reaching its potential in program planning. The use of longitudinal studies to solve control group problems, with standardized criteria for benefit-cost analysis, could eliminate much of the inconsistency in evaluation, with improved information systems at the local project level, the evaluator and policymaker together could plan projects on the basis of accurate comparisons.--*B.H.*

Grimsley, Douglas L. *Acquisition, Retention, and Retraining: Effects of High and Low Fidelity in Training Devices,* Technical Report 69-1, The George Washington University, Human Resources Research Office, HumRRO Division No. 3, Presidio of Monterey, Calif., February 1969a.

To examine the effects of varying fidelity of training devices on acquisition, retention, and reinstatement of a procedural task, soldiers were trained individually to operate the Section Control Indicator (SCI) console of the Nike Hercules guided missile system during preparation and firing status. Subjects with no previous experience on the equipment were trained on one of three panels differing in appearance, functional fidelity, or both, and tested immediately after training. Approximately four and six weeks later, they were retested and retrained to the original level of proficiency. Results indicated that there was no difference in training time, initial performance level, amount remembered after four and six weeks, or retraining time, between individuals trained on high- and low-fidelity devices for procedural tasks.--*Auth.*

Grimsley, Douglas L. *Acquisition, Retention, and Retraining: Training Category IV Personnel with Low Fidelity Devices,* Technical Report 69-12, The George Washington University, Human Resources Research Office, HumRRO Division No. 3, Presidio of Monterey, Calif., June 1969b.

Low (AFQT Mental Category IV) aptitude subjects with no previous experience on the equipment were trained individually to operate a guided missile control panel. Three panels differing in appearance and/or functional fidelity were used. Subjects were tested immediately after training, four and six weeks later, and then retrained to the original level of proficiency. The results indicated that the higher aptitude subjects (from data presented in earlier STRANGER reports) required significantly less training time tham the low-aptitude subjects. For all treatment groups there were no practical differences in training time, initial performance level, amount remembered after four and six weeks, or retraining time between groups trained on high- and low-fidelity devices for this procedural task. Thus, training device selection should be based on a careful review of the tasks to be taught in order to use inexpensive devices where possible.--*Auth.*

Hennessy, D. E. "Profit From Training," *Training in Business and Industry,* Vol. 6, No. 2, 1969, pp. 34-40.

Henry, G. L. *Determination of Manpower Cost Implications Associated With Changes in Navy Reenlistment Rates,* WRM 71-30, Naval Personnel Research and Development Laboratory, Washington Navy Yard, Washington, D. C., March 1971. (AD 724 657)

This is the second, and final report of a study in which: (1) a practical means for calculating and displaying cost implications associated with changing Navy reenlistment rates was developed, and (2) the developed methodology was used to calculate reenlistment cost implications associated with 1% changes in FY 72 first and second term reenlistment rates for each Navy enlisted rating.--*Auth.*

Hook, Marion E. and Massar, Richard S. *Rankorder Estimates of the Time Required for Crosstraining Among 98 Airmen Specialties,* Technical Documentary Report PRL-TDR-62-15, 6570th Personnel Research Laboratory, Aerospace Medical Division, Lackland AFB, Texas, August 1962. (AD 290 551)

When data based on experience are not available, it is often possible to obtain estimates of the relative time required to crosstrain personnel qualified in one specialty to equal proficiency in a second specialty. This paper reports the first study on devising efficient methods for collecting and analyzing such estimates. A procedure was developed for collecting data to form a matrix describing the relative crosstraining-time demands for movements among a group of specialties.

Rank order estimates of the crosstraining-time requirements for the 9506 movements possible among the 98 5-level specialties were obtained from 477 Command and Staff College student officers. A computer program for hierarchical grouping was applied to these data to cluster specialties into groups such that crosstraining-time between specialties within groups is minimized. Mean crosstraining-time estimates were computed at each stage of the clustering procedure as a criterion for evaluating the cost of reducing the number of clusters. For illustrative purposes, the hierarchical structure of the 40-cluster stage is compared with the 40 career-field designations of the 98 specialties.--*Auth.*

Hummel, Lester F. and Newmaster, Ronald D. *Computerized Preparation of Navy Training Manuals,* Report 95, Operations Analysis Department, Navy Fleet Materials Support Office, Mechanicsburg, Pa., 17 January 1973. (AD 754 431)

Navy training manuals require continuing revision in order to remain current. Considerable time and man-effort are required to accomplish the revision of such manuals. The use of a computer assisted document preparation system in the updating of these manuals offers potential for significant reductions in both the elapsed time and the man-effort required to complete a revision cycle. This report relates the results of a pilot project initiated to test the feasibility of using such a computer-based text-editing system to update Navy training manuals. The Computerized Specification Management System (CSMS), a text-editing system developed by Naval Electronics Laboratory Center (NELC), San Diego, California, was used to prepare revised editions of two Navy training manuals and their associated correspondence courses. Modification and enhancement of the original system was required to provide additional font and character capabilities. Significant reductions in elapsed time and man-effort required to update a manual were achieved. Additional texts will be assigned for update via the CSMS system and efforts to refine and improve the system will continue.--*Auth.*

Hunter, Harold G., Lyons, J. Daniel, MacCaslin, Eugene F., Smith Robert G., Jr., and Wagner, Harold. *The Process of Developing and Improving Course Content for Military Technical Training,* Technical Report 69-9, The George Washington University, Human Resources Research Office, HumRRO Division No. 1, Alexandria, Va., May 1969.

Curriculum development procedures in use as of 1966 for first-enlistment technical training in the Army, Navy, and Air Force are analyzed. A model process for training curriculum development was defined from training research findings and practices: (a) analyze the system, (b) develop task inventories, (c) develop a job model, (d) analyze its tasks, (e) derive training objectives, (f) develop the training program, and (g) monitor the trained product and modify the curriculum. A comparison between this model and the training development procedures in use in the service indicated a need for: (a) better procedures for determining the adequacy of training content and the means for improvement; (b) detailed guidance for developing or conducting the first four steps of the model process, criteria for allocating training content to formal instruction or on-the-job learning, performance specifications for graduates, and feedback from training programs; and (c) more opportunities for career fields in training.--*Auth.*

Kopstein, Felix F. and Seidel, Robert J. "Computer-Administered Instruction Versus Traditionally Administered Instruction: Economics," in Atkinson, C. and Wilson, H. A. (eds.), *Computer-assisted Instruction: A Book of Readings,* Academic Press, New York, 1969, pp. 327-362.

An attempt is made to assay the economics of computer-administered instruction (CAI) versus traditionally administered instruction (TAI) in controlling the structure of the learner's stimulus environment in teaching and training situations. There is a discussion of the need for a sound, objective economic appraisal of the value to society as a whole of increments in the breadth and depth of education in the population, and of the influence of varying rates with which these increments are brought about. The necessity for reliable, objective information concerning cost data is emphasized. Projected cost/effectiveness comparisons based on the assumption of equal effectiveness for CAI and TAI are discussed for both civilian and military instruction.--*Auth.*

Lefkowitz, J. "Effect of Training on the Productivity and Tenure of Sewing Machine Operators," *Journal of Applied Psychology,* Vol. 54, No. 1, 1970, pp. 81-86.

It was felt that a significant determinant of the high rate of personnel turnover among a population of female sewing machine operators was inadequate initial training. Two hundred and eight new trainees received either 1, 2, or 3 days' vestibule training. The longer the training, the lower the turnover rate, but the lower the productivity as well. Both effects were statistically significant, but the effects on productivity were deemed of less practical significance. A fourth training group received 3 days integrated vestibule and on-the-job training and achieved the best balance of productivity and employee retention. The more difficult the operation on which a trainee was placed the more likely she was to terminate her employ. Another significant determinant of resignations was employees' encountering a job that was contradictory to their expectations.--*Auth.*

Naval Training Device Center. *Proceedings of the Fourth Annual Naval Training Device Center and Industry Conference* (Held 18-20 November 1969), NAVTRADEVCEN IH-173, Naval Training Device Center, Orlando, Fla., 1969.

A compilation of papers on a variety of technical subjects relating to training device technology. The conference theme, "Cost Effectiveness of Training Devices," provided a common ground for the exchange of new ideas and discussion of mutual problems. This fourth annual conference is part of a continuing program to encourage and develop better liaison between the Naval Training Device Center and the trainer industry.--*Auth.*

Nowrasteh, Daryush M. *Planning and Management Systems for State Programs of Vocational and Technical Education: An Application of Research*, ERIC Clearinghouse on Vocational and Technical Education, Information Series No. 48 (VT 013 638), the Ohio State University, Columbus, Ohio, November 1971.

O'Neill, Dave M. "Determinants of Labor Turnover Costs in the Military," Study 4, Part 1, Volume I of *Studies Prepared for the President's Commission on an All-Volunteer Armed Force*, U. S. Government Printing Office, Washington, D. C., November 1970.

Pieper, W. J., Swezey, R. W., and Valverde, H. H. *Learner-Centered Instruction (LCI): Volume VII. Evaluation of the LCI Approach*, Technical Report AFHRL-TR-70-1, Training Research Division, Air Force Human Resources Laboratory, Wright-Patterson AFB, Ohio, February 1970. AD-713 111.

The evaluation of the Learner Centered Instruction (LCI) approach to training was conducted by comparing the LCI F-111A Weapons Control Systems Mechanic/Technician course with the conventional Air Force course (ABR 32231R) for the same Air Force Specialty Code (AFSC) 32231R on the following dimensions: (1) job performance of course graduates, (2) man-hour and dollar costs of the two courses, and

(3) student acceptability and instructor problems for the LCI course. Measures of job performance included a job performance test, an Air Force practical test, the supervisors' ratings, and a substitute job knowledge test. The graduates were measured both at end of course (EOC) and again after five months in the field at field follow-up (FF). The high aptitude LCI trainees' job performance was superior to the high aptitude conventional course trainees at both EOC and FF, and job performance of the medium aptitude LCI trainees was about the same as that for the high aptitude conventional course trainees. Cost in terms of man-hours and dollars for the LCI course were substantially lower than those for the conventional course. The LCI course was about equally acceptable to the high and medium aptitude trainees, but some of the instructors had misgivings about the LCI approach. This report includes implications of integrating LCI courses into the Air Force training environment.--*Auth.*

Reinhart, Bruce and Blomgren, Glen H. *Cost-Benefit Analysis--Trade and Technical Education*, Final Report, Division of Vocational Education, University of California at Los Angeles, and Bureau of Industrial Education, California State Department of Education, Sacramento, Calif., August 1969, 82 pp. (ED 034 056)

This report contains introductory material on cost-benefit analysis, reviews of cost benefit studies by Andrew J. Corazzini and by Jacob J. Kaufman and others, a discussion of the basic concepts of cost-benefit analysis, and a discussion of two possible approaches to cost-benefit analysis of vocational education: (1) vocational versus academic education, and (2) vocational versus vocational education, which includes on-the-job training costs for graduates of the various curriculums. The report concludes: (1) the typical study thus far has been limited in scope; an implicit problem has been that of comparing different means as alternate means to the same ends, (2) the vocational versus vocational education approach would render unlike curriculums comparable, and (3) cost-benefit analysis is a useful decisional tool for allocating funds, but it assesses only the economic efficiency of a program. A plan for a possible cost-benefit analysis study of vocational education is presented in the appendix.--*J.K.*

Rhode, W. E., Esseff, P. J., Pusin, C. J., Quirk, F. B., and Shulik, R. *Analysis and Approach to the Development of an Advanced Multimedia Instructional System*, Technical Report AFHRL-TR-69-30, Training Research Division, Air Force Human Resources Laboratory, Wright-Patterson AFB, Ohio, May 1970.

In order to examine the possibilities for an advanced multimedia instructional system, this study begins with a comprehensive review and assessment of current instructional media in terms of: (1) a functional description, (2) instructional flexibility, (3) support requirements, and (4) costs. Following this, a model of an individual instructional system is developed as a basis for further analysis. Final comparisons and "trade-offs" among the media are then made to arrive at a recommended media configuration that could serve as a multimedia base for an individualized instructional system. At this point, requirements and features of an automated management information and control subsystem to provide necessary operational control of the total instructional system are outlined and discussed. Finally, the main features of a generalized plan for the development of such a system are described.--*Auth.*

Sewell, David O. "A Critique of Cost-Benefit Analysis of Training," *Monthly Labor Review*, Vol. 90, No. 9, September 1967, pp. 45-51.

This edited version of a critique of cost-benefit analysis illumines the difficulties encountered in measuring the returns from on-the-job training accruing to the individual, society, and government. Its hypothesis, that findings from studies on the Manpower Development and Training Act (MDTA) projects do not transfer to the War on Poverty, supports a request for funding a cost-benefit analysis on training the poor under the Manpower Improvement Through Community Effort project in North Carolina. It criticizes generalizations that have been based upon three published analyses of training schemes conducted under the MDTA Act of 1962, the Area Redevelopment Act of 1961, and earlier State equivalents. It pointed up such difficulties as: (1) treating populations of the poor and unemployed as the same, (2) considering that improvement in income or employment are not the only benefits, and (3) trying to calculate the value of complementary demands for labor created by using the newly trained.--*Auth.*

Short, J. G. and McCombs, J. L. *A Study of the Feasibility of Using Programmed Instructional Techniques in U. S. Navy Correspondence Courses*, Final Report AIR-D70-2/66-FR (Contract NOp-1514 with Bureau of Naval Personnel), American Institutes for Research, Pittsburgh, Pa., February 1966. (AD 803 984)

The positive findings of the study indicate that there would be some increase in training effectiveness and efficiency if programs were used in Navy correspondence courses. Therefore, developmental and administrative costs of programmed and conventional courses were estimated, and comparative cost curves were prepared showing total training costs for different student populations. Program *development costs* are much higher than the present development costs of conventional courses. However, administrative costs associated with scoring assignments and answering student questions are estimated to be lower for programs. Although these administrative costs are small for one student and one assignment, they represent a major cost factor because of the large number of students enrolled in Navy correspondence courses. There are certain student populations for which the higher initial developmental costs of programs can be partially offset by the reduction in continuing administrative costs.--*Auth.*

Smith, Robert G., Jr. *The Engineering of Educational and Training Systems*, D. C. Heath and Company, Lexington, Mass., 1971.

Swann, J. H. *Procedures for Determining Number of Instructors for Navy Enlisted Schools*, PRL Report No. WRR 67-65, Personnel Research Laboratory, Naval Personnel Program Support Activity, Washington, D. C., June 1967.

This report presents the final results of research concerned with the development of procedures for determining the number and indicating the quality of instructors for Navy enlisted schools. The results are presented in the form of an *instrument* designed to be administered by schools to establish their instructor requirements.

The instrument contains procedures for establishing the man-hour workload of instructors as derived from their instructional, preparation, related, and military duties; and then calculation of the number of instructors required to perform the established man-hour workload.

The instrument appears to provide a valid, practical, and operationally feasible basis for determining instructor requirements for Navy enlisted schools. The instrument has been recommended for promulgation.--*Auth.*

Swann, J. H. *Procedures for Determining Number of Instructors for Navy Enlisted Schools*, WRR 68-6, Personnel Research Laboratory, Naval Personnel Program Support Activity, Washington, D. C., November 1967. (AD 824 246)

Tilley, K. W. "Studying the Cost-Effectiveness of Training," in Wilson, N. A. B. (ed.), *Manpower Research* (Proceedings of NATO Conference, London, August 14-18, 1967), English Universities Press Ltd., London, 1969, pp. 348-360.

Tupes, E. C., Dieterly, D. L., Fortuna, A. L., and Madden, H. L. *Development of a Data Base for an AFROTC Management Control System*, Technical Report AFHRL-TR-68-118, Personnel Research Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, December 1968. AD-688 539.

This report describes the origin and rationale of the concept of an AFROTC Management Control System, and the development of a data base upon which such a system must depend. A detailed list and descriptions of all variables in the data base are included. Some example distributions are included to illustrate the type and magnitude of differences existing between the various AFROTC detachments. It is concluded that substantial improvements in the cost-effectiveness of the AFROTC program are possible through the use of the AFROTC Management Control System, but that the interrelationships between the various factors entering into such a system are so complex that the use of an electronic computer in the data analyses is a necessity.--*Auth.*

Tupes, E. C. and Madden, H. L. *The 1969 Updating of the Data File for the AFROTC Management Control System*, Technical Report AFHRL-TR-70-18, Personnel Research Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, June 1970. AD-709 729.

This report describes the background and rationale of an AFROTC Management Control System and the expansion and updating through 1969 of the data base upon which a system must depend. A detailed list and description of 40 detachment effectiveness criteria is presented, with distribution data for 25 criterion variables. Effectiveness criterion scores for selected detachments are described, as are quality control tables developed to indicate the relative effectiveness of each detachment on each criterion. Also described is an effectiveness criterion prediction which makes available predicted scores for more than 800 colleges not presently in the AFROTC program. Examples are shown to demonstrate the usefulness of the system in the pre-evaluation of management decisions.--*Auth.*

Warmbrod, J. Robert. *Review and Synthesis of Research on the Economics of Vocational Education*, Information Series, The Center for Vocational and Technical Education, ERIC Clearinghouse on Vocational and Technical Education, The Ohio State University, Columbus, Ohio, November 1968. (ED 023 937)

Warren, M. W. "Estimating Costs," Chapter 6, in Warren, M. W., *Training for Results: A System Approach to the Development of Human Resources in Industry*, Addison-Wesley, Reading, Mass., 1969, pp. 89-105.

Wethy, R. B. and Bumbak, A. *Utilization Cost of Capital Resources Used by Navy Training Schools: A Methodology*, WRM 71-44, Naval Personnel Research and Development Laboratory, Washington Navy Yard, Washington, D. C., June 1971. (AD 727-102)

This is a research study that developed a methodology for costing capital resources utilization (real property) by Navy training schools. The methodology was applied in several examples demonstrating the capability of the utilization cost methodology to provide Navy training school managers at all levels with a more realistic and representative total training cost.

Wheaton, George R. and Mirabella, A. (American Institutes for Research). *Effects of Task Index Variations on Training Effectiveness Criteria*, Technical Report NAVTRADEVCEN 71-C-0059-1, Naval Training Device Center, Orlando, Florida, March 1972.

Wolff, H. H. "Cost Effectiveness of Training Devices," in *Proceedings of the Fourth Annual Naval Training Device Center and Industry Conference* (held 18-20 November 1969), Naval Training Device Center, Orlando, Florida, 1969, pp. 1-4.

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(For abstract see Section III.)

SECTION VI

TECHNIQUE COMPARISON STUDIES

Technique-comparison studies abound in the training literature. Among the more interesting are those concerned with computer-assisted instruction (e.g., Kopstein and Seidel, 1969); learner-centered instruction (e.g., Pieper, Swezy, and Valverde, 1970); the fidelity of training devices (e.g., Grimsley, 1969a, 1969b, 1969c); programmed instruction (e.g., Short and McCombs, 1966); and multimedia techniques (e.g., Rhode, Esseff, Pusin, Quirk, and Shulik, 1969). General advice on how to conduct such specific comparison studies has been provided by Carpenter (1970).

Unlike the mathematical models of OJT costs, the technique-comparison studies are of great interest to trainers, and are reviewed on a selective basis in the abstract series published in the *Journal of the American Society of Training and Development*. It must be granted, however, that many people do not take this type of study very seriously. If the experimenter's conclusions disagree with the conclusions wanted by the training expert, the experimenter's conclusions can usually be explained away with little effort. For one thing, the studies are almost always conducted by those who have a vested interest in an answer that supports the use of the new technique. The experimental comparisons are almost never adequately controlled; and the number of cost-effective variables dealt with is invariably small. Many studies, for example, use "training time" as an index of cost effectiveness, without measuring the relative performance of personnel in the experimental and control group. Many other studies evaluate trainee performance in a final course examination, but provide no information about performance on the job.

The number of variables that *should* be considered when two techniques are compared is sizeable. A good illustration of what training experts are interested in is once again provided by Walker (1965), who obtained expert ratings of 16 commonly used training techniques using criteria proposed by training experts (Table VI-I).

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Table VI-1

Selection Criteria Matrix: Mean Evaluation Ratings[a]

[illegible]ECTION CRITERIA	TRAINING TECHNIQUES															
	Lecture	Job Experience Training	On-the-Job Training	Discussion Sessions	Closed Circuit TV	Programmed Instruction	Radio, Tape or Record	Film Strip and Audio	Slides and Audio	Telephone Instruction	Sleep Teaching	Sound Films	Laboratory	Simulators	Texts	Tests
Cost to develop	3.8	3.7	4.5	4.4	1.3	2.0	2.8	2.2	2.2	2.8	2.2	1.4	2.3	1.0	2.3	3.7
Cost to teach	3.5	2.9	3.6	4.4	2.4	4.5	4.2	4.1	4.1	2.8	3.0	4.2	2.1	1.9	4.3	4.2
Realism	1.8	4.5	4.9	1.7	3.2	2.4	1.6	3.2	3.1	1.6	1.8	3.4	4.4	4.7	2.1	1.9
Student participation	2.0	4.4	4.9	3.2	1.7	4.3	1.4	1.8	1.8	2.4	2.3	1.7	4.5	4.6	3.0	3.7
Student reinforcement	2.2	4.2	4.7	3.4	1.8	4.1	1.5	1.9	1.9	2.5	2.5	1.8	4.1	4.5	2.4	3.0
Effectiveness of teaching theory	3.4	2.8	2.9	3.7	3.5	4.3	2.6	3.2	3.0	3.0	2.7	3.4	3.2	3.0	3.4	2.4
Student feedback	2.2	3.9	4.3	4.2	1.3	4.1	1.3	1.3	1.4	3.1	1.7	1.2	4.0	3.9	2.0	4.4
No. of instructors to develop	4.3	3.8	3.6	3.9	1.6	2.2	3.0	2.7	2.8	3.6	3.0	1.9	3.5	1.4	2.4	3.9
No. of instructors to instruct	3.4	3.4	3.4	3.0	3.7	4.5	4.3	4.4	4.4	3.2	4.4	4.2	3.0	2.4	4.4	3.7
Transfer of training	2.2	4.4	4.4	2.7	2.8	2.8	1.9	2.7	2.6	2.3	2.3	3.2	4.3	4.6	2.4	2.2
Maneuverability	4.5	2.1	1.8	4.3	1.7	4.7	4.0	3.9	4.0	3.2	2.9	3.9	1.5	1.7	4.7	4.6
Student motivation	2.5	4.5	4.7	3.5	3.4	3.5	2.4	3.1	2.8	2.7	2.8	3.5	4.5	4.5	1.9	2.7
Retention	2.3	4.2	4.7	3.5	2.9	3.7	1.9	2.8	2.7	2.3	2.8	3.0	4.4	4.4	2.6	2.9
Flexibility (adaptability)	4.9	3.8	4.1	4.6	2.0	1.6	1.9	1.7	2.0	4.6	2.5	1.2	2.4	1.2	1.5	3.0
Student knowledge level	3.9	2.6	3.0	3.4	3.3	4.2	2.9	3.1	3.0	3.4	3.4	3.4	2.9	2.8	3.2	2.4
Student-paced	1.6	3.2	3.8	2.8	1.2	4.7	1.6	1.9	1.9	2.6	2.1	1.2	3.8	3.6	4.5	3.4
Quality of specialists to develop material	3.1	2.7	2.8	2.9	1.5	1.9	2.6	2.4	2.4	2.5	1.7	1.7	1.9	1.3	1.8	2.8
No. of students taught	4.4	2.0	1.5	2.6	4.4	4.9	4.4	3.5	3.7	3.2	2.8	4.3	1.7	1.7	4.7	4.3
Facilities needed for preparation	4.7	3.3	3.9	4.5	1.2	3.9	2.5	2.4	2.6	3.4	2.6	1.3	2.4	1.3	3.3	4.4
Facilities needed to present	4.5	2.4	3.0	4.3	1.5	4.7	2.7	2.8	2.8	2.8	2.9	2.3	1.7	1.7	4.6	4.6
Complexity of the training material	2.4	4.2	4.3	2.8	3.0	3.5	1.7	2.8	2.8	2.3	2.4	3.0	4.1	4.3	3.2	2.1
Specific objectives needed	1.8	4.0	3.9	2.7	3.3	4.1	2.9	3.1	3.1	3.2	3.6	3.1	3.2	3.8	3.7	3.7
No. of senses stimulated	2.3	3.8	4.2	2.4	2.9	2.5	2.0	2.9	2.8	2.3	1.9	2.8	4.0	3.8	2.1	2.1
Length of course	4.4	1.7	3.0	4.3	2.3	3.9	3.8	3.7	3.5	3.6	3.1	3.5	2.7	1.2	3.4	3.6
Amount of data needed to prepare	3.8	2.9	3.4	3.8	2.5	2.0	2.7	[illegible]	2.5	2.8	2.7	2.0	2.5	1.5	1.7	2.8
Variety of psychological learning processes	1.6	4.3	4.8	2.7	2.1	3.3	1.5	2.3	2.3	2.0	1.6	2.3	4.3	4.2	2.1	2.7
Simulation of operational environment	1.4	4.3	5.0	1.9	3.1	1.9	1.7	2.9	2.8	1.4	1.7	3.3	4.3	4.5	1.7	1.6
Ease of presentation	3.4	2.4	2.7	3.6	2.4	4.8	3.7	2.4	3.4	2.7	3.4	3.3	2.0	1.7	4.5	4.4
Ease of administration	3.5	2.7	2.8	3.5	3.3	3.4	3.3	3.5	3.5	2.4	3.3	3.6	2.4	2.5	3.5	2.8
Time to produce	3.9	3.4	3.9	3.9	1.7	1.8	2.7	2.3	2.4	2.9	2.5	1.8	2.4	1.0	1.7	3.3
Ease of evaluating students	2.0	3.3	4.1	2.6	1.7	4.0	1.8	1.9	1.9	2.1	2.3	1.9	3.6	4.2	2.4	4.7
Student competition	1.9	3.2	3.6	4.0	1.5	2.7	1.6	1.7	1.7	2.1	1.5	1.6	3.8	4.4	1.9	4.0
Level of student intelligence	2.1	4.2	4.7	2.3	2.7	3.7	2.3	2.8	2.8	1.8	2.8	3.4	3.7	4.2	1.8	1.9
Effectiveness of teaching motor skills	1.3	4.5	4.9	1.5	2.5	1.8	1.5	2.3	2.3	1.5	1.6	2.7	4.6	4.7	1.7	1.4
Total	101	118	129	113	81	116	85	93	93	91	87	90	110	102	97	109

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[a] From Walker, Ralph W. (1965).

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(For abstract, see Section V, Bibliography.)

Short, Jerry G. and McCombs, J. Lynne. *A Study of the Feasibility of Using Programmed Instructional Techniques in U.S. Navy Correspondence Courses*, (AIR-D70-2/66-FR), Final Report for the Bureau of Naval Personnel (PTB 66-4), American Institutes for Research, Pittsburgh, Pa. (AD 803 984)

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Walker, R.W. "An Evaluation of Training Methods and Their Characteristics," *Human Factors*, Vol. 7, No. 4, 1965, pp. 347-354.

(For abstract, see Section V, References.)

There are, of course, thousands of technique comparison studies in the training literature. Those that seemed to have special relevance for Air Force OJT programs are given here.

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This study determined that field-experienced instructors teaching technical courses in Air Training Command produced no better students than did instructors lacking field experience. However, the field experienced instructors were rated higher by their supervisors and were considered more favorably by the students they taught. ATC has circulated this information to all of its training centers.--*Auth.*

Biel, W.C. "Training Programs and Devices," in Gagné, R.M. (ed.), *Psychological Principles in System Development*, Holt, Rinehart & Winston, New York, 1962, pp. 343-384.

Boguslaw, R. and Porter, E.H. "Team Functions and Training," in Gagné, R.M. (ed.), *Psychological Principles in System Development*, Holt, Rinehart & Winston, New York, 1962, pp. 387-416.

Bond, Nicholas A., Jr. and Rigney, Joseph W. *Measurement of Training Outcomes*, Technical Report No. 66, Behavioral Technology Laboratories, University of Southern California, Los Angeles, Calif., June 1970. (AD 711 302)

Measurement of training outcomes is a requirement for evaluating new training techniques, but is one that is difficult to meet.

Managers of education and training may have different concepts of what they want, as favorable outcomes, than do the investigators doing the research. Classical statistical and experimental designs assume laboratory rigor of control over variables that is seldom possible in the real world of a school or classroom. Yet in the broader perspective of educational institutions, the effectiveness of these institutions is a current issue of fundamental concern in our society. In this report, possibilities for measuring outcomes of training are surveyed, considering training as a form of planned social change. Approaches that are discussed include the classic Solomon four-group design, iterative adaptation to the peculiarities of individual student progress, response surface designs, adaptive control models, decision theory models, and simulation models. Illustrations from the CAI literature of recent attempts to measure training outcomes are given. The principal conclusions presented are that the classical four-way design is impracticable for most evaluation studies in training environments; that a policy of "adaptive research for big effects" is apt to be scientifically and administratively desirable and that current attempts at measurement of training outcomes still use fairly simple methods.--*Auth.*

Briggs, Leslie J. *Sequencing of Instruction in Relation to Hierachies of Competence,* Monograph No. 3, American Institutes for Research, Pittsburgh, Pa., 1968.

Brock, John F. *A Preliminary Investigation Into Shipboard Training Problems. Final Report,* SRR 72-1, Naval Personnel and Training Research Laboratory, San Diego, Calif., July 1971. (AD 726 689)

A preliminary investigation into applying the NPTRL course design procedure to a ship's repair party training program is reported. A training system was developed for repair party training which was workable and produced readily detectable improvements. The procedure proved adaptable to shipboard conditions. Most problems of shipboard training reduce to management problems, rather than the actual conduct of training. There is tentative evidence that smaller repair parties, with personnel cross-trained in two or more discreet jobs, would be more efficient. Further research in the shipboard training area is suggested.--*Auth.*

Caro, Paul W. *Equipment-Device Task Commonality Analysis and Transfer of Training,* Technical Report 70-7, Human Resources Research Organization, HumRRO Division No. 6, Fort Rucker, Ala., June 1970.

Procedures were developed to enable training personnel to systematically and objectively determine the potential utility of training devices for teaching how to perform missions in operational equipment. The procedures allow comparison of operational task stimulus and response elements with corresponding elements in synthetic training equipment. On the basis of such information, training programs consistent with the psychological principles underlying transfer of training may be developed. The procedures may be applied to the potential use of training equipment in a training situation other than that for which it was designed, or in determining the applicability of "off-the-shelf" training devices to specific training requirements. The procedures, termed Task Commonality Analysis, were developed in connection with an Army rotary wing instrument flight training program. In an application of the procedures in that program, transfer of training predictions were generally consistent with empirical evidence collected earlier.--*Auth.*

Childs, Gayle B. "Supervised correspondence instruction," in Wedemeyer, Charles A. (ed.), *The Brandenburg Memorial Essays on Correspondence Instruction: I,* University of Wisconsin, University Extension Division, Correspondence Instruction Program, Madison, Wisc., 1963, pp. 22-33.

Supervised correspondence study has made a major contribution to education in this country. It is equally clear that the full potential of the procedure is far from being realized.--*Auth.*

Cunningham, J.W. (ed.), *The Job-Cluster Concept and Its Curricular Implications: A Symposium,* Center Monograph No. 4, Department of Psychology, North Carolina State University at Raleigh, N.C., 1969.

Among the many problems facing occupational education today, one of the most pressing is that which relates to the analysis and classification of jobs. In attempting to improve the quality of vocational education, it is necessary to know the characteristics of the product that is needed, as well as the process by which it is produced. Research into the area of job-clustering has great potential for helping us to understand the nature of the desired end-product of vocational education. The potential for curriculum development is apparent, but that is not the only possible contribution. A better understanding of job-analysis, a necessary foundation for clustering research, should give greater feedback capabilities in occupational programs with a concomitant improvement in the ability to modify and redirect occupational programs to provide the best articulation with the world of work. The papers collected in this monograph represent the contributions of a number of scholars who are presently active in research on the problems of job-clustering.--*Auth.*

Davis, R.H. and Behan, R.A. "Evaluating System Performance in Simulated Environments," in Gagné, R.M. (ed.), *Psychological Principles in System Development,* Holt, Rinehart & Winston, New York, 1962, pp. 477-515.

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Glaser, R. and Klaus, D.J. "Proficiency Measurement: Assessing Human Performance," Gagné, R.M. (ed.), *Psychological Principles in System Development*, Holt, Rinehart & Winston, New York, 1962, pp. 419-474.

Hooprich, E.A. and Matlock, E.W. *Printed-Circuit-Board Soldering Training for Group IV Personnel*, SRR 71-11, Naval Personnel and Training Research Laboratory, San Diego, Calif., October 1970. (AD 713 639)

As part of a larger program to determine which Navy skills can be learned by lower aptitude personnel and to ascertain what methods are most effective for accomplishing such training, an experimental course in printed-circuit-board soldering was administered to 186 Mental Group IV students in 13 classes. Two different training approaches--one stressing instructor guidance and the other featuring reliance on film viewers--were evaluated. Research data were obtained by means of questionnaires and paper-and-pencil and performance tests. The soldering proficiency of the Group IVs was compared with that of experienced Navy technicians, and tests designed to measure transfer of the skills learned in the course also were constructed and administered to selected classes. The major research findings were: (1) that Group IVs can learn the rather exacting skills required for a task such as printed-circuit-board soldering, but they require a considerably longer training period than other Navy personnel; and (2) that the filmviewer method of training is an effective alternative to conventional methods of teaching soldering and was preferred by the Group IV personnel. Recommendations for implementing the research findings into Navy technical training are presented, and other current and planned research projects are briefly discussed.--*Auth.*

Horowitz, Morris A. and Herrnstadt, Irwin L. (Department of Economics, Northeastern University). *A Study of the Training of Tool and Die Makers*, prepared for Manpower Administration, U.S. Department of Labor, Washington, D.C., September 1969. (PB 187-558)

Hughes, John L. (ed.). *Programmed Learning: A Critical Evaluation* (A publication of the Foundation for Research on Human Behavior), Educational Methods, Inc., Chicago, 1963, 238 pp.

Hummel, Lester F. and Newmaster, Ronald D. *Computerized Preparation of Navy Training Manuals*, Report 95, Operations Analysis Department, Navy Fleet Material Support Office, Mechanicsburg, Pa., 17 January 1973. (AD 754 431)

Navy training manuals require continuing revision in order to remain current. Considerable time and man-effort are required to accomplish the revision of such manuals. The use of a computer-assisted document preparation system in the updating of these manuals offers potential for significant reductions in both the elapsed time and the man-effort required to complete a revision cycle. This report relates the results of a pilot project initiated to test the feasibility of using such a Computerized Specification Management System (CSMS). This text editing system developed by Naval Electronics Laboratory Center (NELC), San Diego, California, was used to prepare revised editions of two Navy training manuals and their associated correspondence courses. Modification and enhancement of the original system was required to provide additional font and character capabilities. Significant reductions in elapsed time and man-effort required to update a manual were achieved. Additional texts will be assigned for update by the CSMS system and efforts to refine and improve the system will continue.--*Auth.*

Jackson, Rex. *Developing Criterion-Referenced Tests*, ERIC Clearinghouse on Tests, Measurement, and Evaluation, Princeton, N.J., June 1970, 18 pp. (ED 041 052)

Klaus, David J. and Glaser, Robert. *Increasing Team Proficiency Through Training: 8. Final Summary Report*, AIR-E1-6/68-FR, Team Training Laboratory, American Institutes for Research, Pittsburgh, Pa., May 1968.

This report summarizes the results of research at the Team Training Laboratory from December 1960 until August 1967. During this time, seven technical reports were issued by the laboratory. This summary report briefly describes each of these seven studies and reviews their purpose and major results.

Report 1 described the approach being examined in the Team Training Laboratory, one which considered the team and its output or product rather than the performance of its individual members as the focus of investigation.

Report 2 reported on the acquisition and extinction of a team response, a demonstration that basic principles of individual learning could be applied to the team considered as a single entity.

Report 3 presented an experiment on the inclusion of parallel or "redundant" members in a team which confirmed an hypothesis derived from the underlying approach that redundancy could result in eventual decrements in team performance.

Report 4 further analyzed the effects of internal team structure on the development and maintenance of a team response based upon the degree of correspondence between individual performance and feedback supplied to the team.

Report 5 identified the relationships among team member characteristics, the conditions of team training and the speed and thoroughness with which teams developed proficiency that could be demonstrated empirically.

Report 6 explained the value of more gradually introducing the low ratios of reinforcement typical of early team performance providing supplemental, supervisory-furnished feedback to team members.

Report 7 presented three studies on the simulation of team environment, which considered the degree to which the approach facilitated the replication of team learning phenomenon based upon the performance of a single individual.

The final section of this report identifies some practical implications of this research and relates the underlying concepts to the broader context of social behavior.--*Auth.*

Lee, Seong Soo. "Transfer From Lower-Level to Higher-Level Concept," *Journal of Verbal Learning and Verbal Behavior*, Vol. 7, 1968, pp. 930-937.

Two experiments were carried out: one to test a hypothesis about the operation of the learned hierachy of concepts and the other to examine the function of attribute-coding responses. The main variable in Exp. 1 was the number of lower-level concepts to be learned. The main variable in Exp. 2 was the amount of pretraining on attribute-coding responses.

Pretraining on all three of the lower-level concepts facilitated the acquisition of a presumed higher-level, biconditional concept significantly more than other conditions. Pretraining on the attribute-coding responses prior to rule-learning proper also facilitated the acquisition of the transfer concept significantly more than did no training in coding. Thus, the second experiment yielded empirical support for an interpretation of the transfer effects apparent in the learned hierarchy of concepts in terms of two processes: (a) implicit or explicit attribute-coding, and (b) rule formulation proper.--*Auth.*

Main, Ray E. *The Effectiveness of Flash Cards in a Mathematics Self-Study Course for Group IV Personnel*, SRM 70-20, Naval Personnel and Training Research Laboratory, San Diego, Calif., June 1970. (AD 707 718)

The Naval Personnel and Training Research Laboratory is conducting research aimed at identifying optimal methods for training Navy personnel who have achieved marginal scores on military selection tests. In the present study, flash card instruction methods were adapted for application to a comprehensive range of basic mathematical operations involved in a previously developed course in fundamental mathematics. Supplementing the standard course work with flash-card instruction did not result in significantly higher performance gains. It was concluded that applying flash methods to the relatively wide range of content complexity involved in this study was not effective. It is pointed out that this investigation should not be interpreted as challenging the usefulness of flash cards as typically employed.--*Auth.*

Meyer, John K. and Abrams, Macy L. *Development of a Strategy to Retrieve Information From the Standards Used to Evaluate Welds and Metals by Nondestructive Testing*, SRR 71-20, Naval Personnel and Training Research Laboratory, San Diego, Calif., April 1971. (AD 883 413)

This study reflects the initial research effort to improve the training technology in the nondestructive testing (NDT) training course. A strategy was developed to retrieve information from the Welding Standard (NAVSHIPS 250-1500-1), one of the primary military/Navy standards (documents) that is used to evaluate welds and metals by NDT methods. This strategy, an index and retrieval exercise, was then experimentally evaluated by comparing groups using it with those groups not using it. Improvements were demonstrated in the capability of finding inspection topics, the interpretation of inspection topics, and in the length of time required. Recommendations are made for the implementation of the index and the retrieval exercises, and for developing similar index documents and retrieval exercises for all standards involved in the NDT of welds and metals.--*Auth.*

Nelson, Hilding E. *National Institute on Innovative Curriculum in Vocational-Technical Education*, Final Report, Vocational-Industrial Education Research Report, prepared by the Department of Vocational Education, Pennsylvania State University for Bureau of Research, Office of Education and Welfare, Washington, D.C., August 1969, 295 pp.

This document reports on two institutes designed to communicate new concepts and procedures in vocational-technical education curriculum development to potential change agents in the various states.

Formal presentations by 12 consultants and task force activities concerned innovation identification and prognoses for change, planning strategies for curriculum innovation, climates for innovation and change, implementing and expanding innovation, and cost-benefits and evaluation criteria. Institute evaluation is discussed in detail. Institute participants represented 31 states. Complete texts of formal presentations are appended--*C.H.*

St. Michel, K.A. and Swanson, C.L. *A Microfilm System for Improving the Dissemination of Navy Occupational Information to Recruits: A Feasibility Study*, SRR 69-18, Naval Personnel and Training Research Laboratory, San Diego, Calif., March 1969. (AD 687 430)

This research evaluated the feasibility of a microfilm system for providing information about Navy ratings to recruits and evaluated the adequacy of Navy job information presently being given to recruits. Additionally, it provided information about: (a) what job information is considered most important, (b) the effectiveness of different ways of learning about Navy occupations, and (c) the recruits' expressed satisfaction regarding job assignments. The microfilm system that was investigated was considered too costly for implementation in current recruit training. A recommendation for tryout and evaluation of a simplified microfilm method was made.--*Auth.*

Standlee, L.S., Matlock, E.W., and Harrigan, R.J. *Development of Methods and Materials for Soldering Training*, SRR 71-19, Naval Personnel and Training Research Laboratory, San Diego, Calif., February 1971. (AD 720 308)

Two parallel self-instructional packages were developed for teaching soldering rework on printed circuit boards. One package consisted of 12 five-minute sound films. The other consisted of a 168-page spiral bound book. The effectiveness of the self-instructional packages was compared to that of a parallel instructor-taught course. Subjects for the comparison experiment consisted of 60 students in Basic Electricity and Electronics.

Both self-instructional packages--film and book--were found to be effective media for learning soldering skills. No significant difference was found in the soldering skill gains of film-, book-, and instructor-taught students. The soldering book, though, has the advantage of being simpler and less expensive to reproduce and to administer.--*Auth.*

Taylor, John E., Montague, Ernest K., and Michaels, Eugene R. *An Occupational Clustering System and Curriculum Implications for the Comprehensive Career Education Model*, HumRRO Technical Report 72-1, Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif., January 1972.

Design of a proposed occupational clustering system for the Comprehensive Career Education Model (CCEM) was to meet three general criteria: encompass most existing jobs, translate into an entire K-12 curriculum, and show clear advantages over other systems. Researchers examined existing clustering systems for relevance and possible adaptation; no one system met all the criteria; so, a new clustering system was devised by synthesizing useful features of existing systems. The proposed system has two crucial dimensions--one stressing functions and contents of occupations, the other emphasizing status or levels of occupations. The proposed clustering system was planned to fulfill three instructional functions: inform students about the world of work, assist students in choosing a suitable career, and provide models to shape instructional objectives and learning experiences.--*Auth.*

Wedemeyer, Charles A. (ed.). *The Brandenburg Memorial Essays on Correspondence Instruction--I*, University Extension Division, Correspondence Instruction Program, Madison, Wis.; 1963, 77 pp.

In August 1961, the Brandenburg Foundation made its first memorial grant to The University of Wisconsin Extension Division for the purpose of assisting the university in carrying on seminars in correspondence instruction and publishing every other year a volume of original papers on correspondence instruction, of which this is the first. There is a very brief review of the literature of the field in the foreword. Titles, authors, and author locations of the collected papers are: "Liberal Education for Adults by Mail," by Leonard S. Stein, St. Louis University; "The Demands of the Decade," by John L. Davies, State University of Iowa; "Supervised Correspondence Instruction," by Gayle B. Childs, University of Nebraska; "Tutoring Through the Mail," by Katherine W. McMullen, University of Wisconsin; "Problems in Learning by Correspondence," by Charles A. Wedemeyer, University of Wisconsin; "W.H. Lighty--Fountain of Idealism," by Roger W. Axford, University of Wisconsin; and "Some Aspects of Teaching by Correspondence in Australia," by Renee Erdos, New South Wales Department of Technical Education, Australia.--*Auth.*

Wedemeyer, Charles A. (ed.). *The Brandenburg Memorial Essays on Correspondence Instruction--II*, University of Wisconsin Press, Madison, Wis., 1966, 156 pp.

Various aspects of correspondence education are explored in 13 essays by various authors, including the editor. In respective essays, current worldwide trends in correspondence education are summarized, its development in several countries is discussed, its purposes are explored, its weaknesses and advantages are analyzed, methods of evaluating it are proposed, and predictions about its future are offered. The contents are: "World Trends in Correspondence Education," by Charles A. Wedemeyer; "Correspondence Education in Developing Countries," by Homer Kempfer; "Teaching Through Television," by Harold Wiltshire and Fred Bayliss; "The Expansion of Educational Opportunity in Venezuela," by Pedro Tomas Vasquez; "New Developments in the Production of Swedish Correspondence Courses," by Borje Holmberg; "New Horizons in Correspondence Education," by Philip Lambert, Eldo C. Koenig and William O. Vebber; "The Search for Purpose in Correspondence Education," by Ripley S. Sims; "Words without Gestures," by George Hartung; "The Role of the Instructor in Correspondence Study," by Margaret I. Knowles; "Promoting Correspondence Instruction," by Clarence A. Schoenfeld; "A Self-Evaluation Study of the Correspondence Method," by Harold Glen Clark; "Review of Research in Correspondence Study," by Gayle B. Childs; "Extension Education and Its Tools in the Next Half Century," by Charles A. Wedemeyer.--*Auth.*

Wedemeyer, Charles A. "Problems in learning by correspondence," in Wedemeyer, Charles A., (ed.), *The Brandenburg Memorial Essays on Correspondence Instruction: I.* University of Wisconsin, University Extension Division, Correspondence Instruction Program, Madison, Wis., 1963, pp. 46-54.

Certain problems of the correspondence learner might possibly be special hazards of the correspondence method. These problems do not result from deficiencies in the method (for the problems appear in other methods, too), but ignoring these problems or failing to work imaginatively to overcome them may offer greater hazards for the correspondence student than for students of other methods.--*Auth.*

SECTION VII

SYSTEMS ANALYSIS OF TRAINING

The training program design literature is very useful and interesting to training experts. This literature is especially important because of recent technical breakthroughs in the design of training programs that would tend to integrate program evaluation and training program design as part of a "systems analysis" or "systems engineering" approach to training.

Systems analysis of training refers to a set of procedures for designing or redesigning programs of instruction. One might think of it as a feedback-oriented approach to the design of instructional programs since, in essence, it consists of an analysis of the tasks the student is expected to perform following training; identification of the terminal behaviors that jointly make up the tasks; measurement of these terminal behaviors; and revision of the program of instruction until performance specifications are met. In other words, the objectives of the program are defined at the outset, and the training program is revised repeatedly until it meets those objectives. A "systems analysis" emphasis shows up in several ways. Job analyses are conducted from a systems point of view, and systems diagrams are used extensively in making decisions about training-program design.

The Air Force version of systems analysis of training is called Instructional System Development (ISD) and is presented in Figure VII-1. The Air Force approach has proved to be very effective, as indicated by the many complimentary comments in a recent OSD-sponsored analysis of curriculum development policies and procedures used by Army, Navy, and Air Force (Hunter, et al.).[7] Moreover, the Air Force has improved its approach since the survey was conducted.

The origins of systems analysis of training are difficult to trace, since so many different organizations seemed to have been working on the problem at the same time. The Army and the Air Force were key organizations in developing the operational plans for systems engineering of training. The military experts who did the work based

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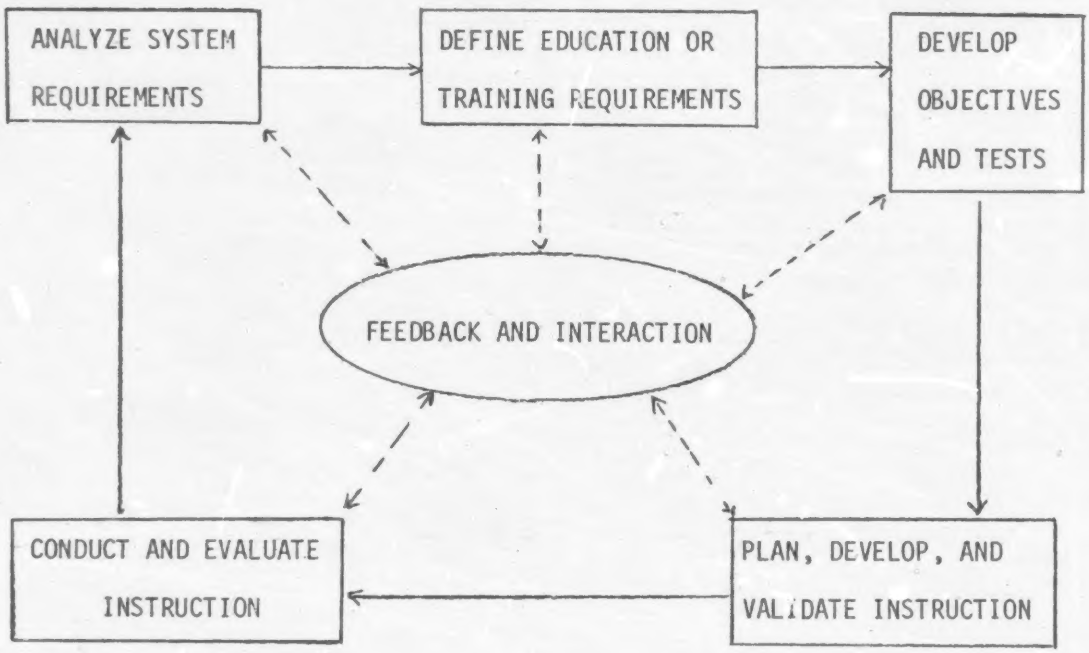
[7] Hunter, Harold G., Lyons, J. Daniel, MacCaslin, Eugene F., Smith, Robert G., Jr., and Wagner, Harold. *The Process of Developing and Improving Course Content for Military Technical Training,* The George Washington University, Human Resources Research Office, HumRRO Division No. 1, Alexandria, Va., May 1969.

INSTRUCTIONAL SYSTEM DEVELOPMENT MODEL


ANALYZE SYSTEM REQUIREMENTS
DEFINE EDUCATION OR TRAINING REQUIREMENTS
DEVELOP OBJECTIVES AND TESTS
FEEDBACK AND INTERACTION
CONDUCT AND EVALUATE INSTRUCTION
PLAN, DEVELOP, AND VALIDATE INSTRUCTION

Legend:

⟶ Curriculum Loop
⇠ - - - - ⇢ Feedback and Interaction Loop

Figure VII-1. Instructional System Development Model. (Source: AFM 50-2.)

it upon training research conducted by large behavioral science organizations, such as the Human Resources Research Organization (HumRRO) and the American Institutes for Research (AIR)--but the act of putting all the pieces together at one time into one systematic approach seems to have been conducted by committees and boards of military training experts who prepared systems engineering manuals for Army and Air Force use. The Navy has recently developed a similar manual for use by its schools and training centers.

Systems analysis of training is expensive, and it has been applied almost exclusively to the design of lengthy resident school training programs. Similar procedures are talked about in the design of OJT programs, but the responsibility for the design of these programs is basically supervisory. One can tell a busy supervisor that he is supposed to conduct task analyses and think in terms of terminal and enabling performance objectives--but, generally, the supervisor simply does not have the time or the skill required to do a professional job of this sort. So as a result, the application of systems-oriented techniques to OJT is more of a long-range objective than it is a current reality.

Many systems analysis manuals have been developed. The following Bibliography presents documents that qualify as important systems engineering training manuals from diverse sources.

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Butler, F.C., Jr. *Job Corps Instructional Systems Development Manual*, Rocky Mountain Educational Laboratory, Inc., Denver, Colo., 1967.

DeCecco, J.O. *The Psychology of Learning and Instruction: Educational Psychology*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1968.

Deterline, W.A. *Principles and Practice of Instructional Technology: Workbook*, General Programmed Teaching, Palo Alto, Calif., 1968.

Drumheller, S.J. *Handbook of Curriculum Design for Individualized Instruction: A Systems Approach*, Educational Technology Publications, Englewood Cliffs, New Jersey, 1971.

Gilbert, T.F. "Mathetics: The Technology of Education," *Journal of Mathetics*, Vol. 1, 1962, pp. 7-73.

Gropper, G.L. and Short, J.G. *Design of a Training Development System*, American Institutes for Research, Pittsburgh, Pa., 1969.

Hamrens, D.G. "Instructional Systems Development," in Crawford, J. (ed.), *CORD National Research Training Manual*, Teaching Research Division of the Oregon State System of Higher Education, Monmouth, Oregon, 1969.

Postlethwait, S.N., Novak, J., and Murray, H.T., Jr. *The Audio-Tutorial Approach to Learning*, Burgess Publishing Company, Minneapolis, Minn., 1964.

Rundquist, Edward A. *Job Training Course Design and Improvement* (2nd ed.), Research Report SRR 71-4, Naval Personnel and Training Research Laboratory, San Diego, Calif., September 1970. (AD 876 204)

The second edition of the course design manual is a thorough revision of earlier editions. The manual is designed to assist instructors in developing and improving job-related training courses. Major changes from earlier editions include more careful definitions of training and training-related terms; a general clarification of concepts and procedures, especially those concerned with job and skill analysis for training purposes; more emphasis on principles of developing training exercises; a more thorough consideration of the importance and means of adapting individual differences; and more emphasis on the significance of the course mission for course design. Examples from a wide variety of duty assignments are included.--*Auth.*

Smith, Robert G., Jr. *The Design of Instructional Systems*, HumRRO Technical Report 66-18, The George Washington University, Human Resources Research Office, Alexandria, Va., November 1966.

Tosti, D.T. and Ball, J.R. *A Behavioral Approach to Instructional Design and Media Selection*, Westinghouse Learning Corporation, Albuquerque, New Mexico, 1969.

Tuckman, B.W. *A Study of Curriculums for Occupational Preparation and Education (Scope Program: Phase 1)*, Rutgers University, New Brunswick, New Jersey, 1970.

Twelker, P.A. "Designing Instructional Systems," in Crawford, J. (ed.), *CORD National Research Training Manual*, Teaching Research Division of the Oregon State System of Higher Education, Monmouth, Oregon, 1969.

U.S. Department of the Air Force. *Instructional System Development*, AFM 50-2, Headquarters U.S. Air Force, Washington, D.C., 1970.

U.S. Department of the Army. *The Development of Instructional Systems. Procedures Manual*, U.S. Army Security Agency Training Center and School, Fort Devens, Mass., 1967.

U.S. Department of the Army. *Systems Engineering of Training (Course Design)*, U.S. Continental Army Command, Fort Monroe, Va., 1968.

U.S. Department of the Navy. *Fundamentals of Navy Curriculum Planning*, NAVPERS 93510-1, Bureau of Naval Personnel, Washington, D.C., October 1968.

SECTION VIII

APPROACHES TO PROGRAM EVALUATION

The Air Force has been concerned with ways of evaluating training programs for some time, and recently sponsored a literature review on this subject. The report (Bergman and Siegel, 1972) reviews the literature on training evaluation and student achievement measurement (316 references). This literature review was then used as the basis for the design of a "how-to-do-it" manual that was made available to training experts as well as to researchers in the Air Force (Siegel, Bergman, Federman, and Sellman, 1972). These two documents, however, are oriented primarily toward resident school courses rather than OJT.

The most important point to be made here is that there are many different approaches to the evaluation of OJT programs; Siegel *et al.* (1972), Rafacz and Foley (1973), and other experimental-oriented experts stress the use of performance checklists and rating scales. Programs can also be evaluated in terms of their cost-effectiveness from an approach of planning programming and budgeting systems (PPBS) (Nowrasteh, 1971; Hennessy, 1969); the statistical characteristics of the overall program (Iacobelli, 1971); the actual behavior of the program graduates (Hahn, 1970, 1973); and so on.

The decision as to which program evaluation technique should be used under what circumstances is not an easy one. Rose (1968) maintains that eight different portions of the training cycle should be evaluated with one or more of 13 different techniques. The eight elements requiring evaluation are job-task analysis, training requirements, plan for training, administration of program, formal training process, OJT process, end-of-course outcomes, and performance on the job. The 13 recommended methods for evaluating these various training program elements are cited here. This list is a useful one, but probably contains no surprises for those in the training business.

(1) Comparison with the findings of educational research and the psychology of the learning process.

(2) Comparison with performance requirements on the job.

(3) Observation of instruction.

(4) Written achievement tests.

(5) Questionnaire to trainees.

(6) Questionnaire to supervisors.

(7) Trainee interview.

(8) Supervisor interview.

(9) Observation of performance on the job.

(10) Study of records and reports.

(11) Performance tests.

(12) Analysis of problems and accidents.

(13) Research with matched groups.

One of the problems with the typical approach to training evaluation is that it does not give adequate consideration to the viewpoint of the trainees. The objectives of the trainees differ from the objectives of the organization for which they work, and any evaluation process based solely upon organizational objectives is not complete.

It is not, of course, always clear what the trainee objectives are. One study, a factor analysis of variables of interest to young trainees, produced the following factors:

(1) Community adjustment.

(2) Striving for personal improvement.

(3) Realistic aspirations.

(4) Job motivation and planning.

These factors seem to have obvious implications for "motivational" problems of trainees--but they tend to be neglected when training programs are evaluated.

Putting more emphasis on ratings by trainees is one way in which attention can be focused upon trainee objectives as well as organizational objectives. This approach is especially useful when graduates of vocational training programs (e.g., U.S. Department of Labor, 1970) evaluate the training that they have received since the graduates are in a better position to evaluate their training than they were as trainees. Graduates are also much less concerned about adverse reactions from their trainers when they make critical comments. A bibliography of program evaluation references, other than those cited in the text, that seemed useful to those concerned with Air Force OJT programs is also given.

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Bergman, Brian A. and Siegel, Arthur I. *Training Evaluation and Student Achievement Measurement: A Review of the Literature,* Technical Report AFHRL-TR-72-3, Technical Training Division, Air Force Human Resources Laboratory, Lowry, AFB, Colo., January 1972. AD-747 040.

Hahn, Clifford P. *Development of Task Level Job Performance Criteria. Interim Report on Phase I,* AIR-24300-2/73-IR, prepared for Air Force Human Resources Laboratory (Contract F41609-71-C-0010; Item 0001AA-CDRL Sequence No. A002), by American Institutes for Research, Silver Spring, Md., 1973.

This report describes the activities undertaken in the accomplishment of Phase I of a planned three-phase project designed to create and evaluate a methodology for the development of task-level job-performance criteria. The primary objectives of the project were the initial development and the later evaluation through field trials of instruments and procedures that could provide the armed services with an acceptable measure of job-task performance. The resulting criterion instruments and procedures were to be designed for use in personnel management, systems development, planning, and evaluation rather than as a basis for immediate actions that affect the personal careers or compensation of individual servicemen. Project activities were to be addressed to a limited number of Air Force specialty career ladders. The basic intent of the project, however, was the development of illustrative methodology that could be readily translated across many Air Force specialties, as well as to related occupational specialties across all military services.

The scope of Phase I, which is covered in this report, included the selection of the occupational specialties to be studied, and the development and preliminary evaluation of survey instruments and procedures preparatory to a field administration to be accomplished in Phase II.--*Auth.*

Hahn, Clifford P. "Methods for Evaluating Counter-Measure Intervention Programs," in *Evaluative Research Strategies and Methods* (proceedings of a seminar held 8-9 January 1970), American Institutes for Research, Pittsburgh, Pa., 1970.

Hennessy, D.E. "Profit From Training," *Training in Business and Industry,* Vol. 6, No. 2, 1969, pp. 34-40.

Iacobelli, J.L. *Training in Private Industry: Policies, Attitudes, and Practices of Employers in Greater Cleveland,* Manpower Research Monograph No. 22, U. S. Department of Labor, Manpower Administration, 1971.

Nowrasteh, Daryush M. *Planning and Management Systems for State Programs of Vocational and Technical Education: An Application of Research,* ERIC Clearinghouse on Vocational and Technical Education, Information Series No. 48 (VT 013 638), The Ohio State University, Columbus, Ohio, November 1971.

Rafacz, Bernard A. and Foley, Paul P. *Preliminary Results on the Evaluation of a Fleet Post-Training Performance Evaluation Technique,* WTR 73-10, Naval Personnel Research and Development Laboratory, Washington Navy Yard, Washington, D.C., January 1973. (For abstract, see p. 92, Bibliography.)

Rose, Homer C. "A Plan for Training Evaluation," *Training and Development Journal,* Vol. 22, No. 5, 1968, pp. 38-51.

Siegel, Arthur I., Bergman, Brian A., Federman, Philip, and Sellman, Wayne S. *Some Techniques for the Evaluation of Technical Training Courses and Students,* AFHRL-TR-72-15, Technical Training Division, Air Force Human Resources Laboratory, Lowry AFB, Colo., February 1972. AD-753 094.

U.S. Department of Labor, Manpower Administration. *Toward the Ideal Journeyman, Volume 1. An Optimum Training System in Apprenticeable Occupations,* Manpower Research Monograph No. 20, Manpower Administration, Washington, D.C., 1970.

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American Institutes for Research. *Evaluative Research, Strategies and Methods,* American Institutes for Research, Pittsburgh, Pa., 1970.

In planning this seminar, it was originally intended as a meeting of AIR staff only; those interested and experienced in evaluation. Because AIR's work in the field, both in this country and overseas is increasing, we sought to have staff within and between offices meet to discuss the timely topic of evaluative research.

The AIR Board of Directors felt there were other groups and individuals who would be interested in the topic and who could provide additional slants and insights. It was agreed to invite a selected group of participants. The response was most rewarding; more than 200 accepted the invitation to meet on 8 and 9 January 1970 in Washington, D.C., to discuss Evaluative Research: Strategies and Methods.

The objectives of the seminar were to provide opportunities for both staff and colleagues to gain 1) new insight or perspective on the broad problems of evaluation, and 2) additional knowledge about methods for dealing with these problems.

This report includes the eight papers presented during the two-day meeting together with supplementary comments. The success of the seminar rested largely on the high quality of these presentations. Dr. Arthur A. Lumsdaine, Chairman, Department of Psychology, University of Washington, commented on the first four papers. On the second day, the commentator was Dr. Irving Spergel, Chairman, Community Work Sequence, School of Social Service Administration, University of Chicago. The speakers and participants appreciated the added perspective these commentators provided.--*Auth.*

Baldwin, Thomas S. (University of Illinois). *The Development of Achievement Measures for Trade and Technical Education*, U.S. Department of Health, Education, and Welfare, Office of Education, Washington, D.C., September 1970.

Belasco, James A. and Trice, Harrison M. *The Assessment of Change in Training and Therapy*, McGraw-Hill Book Co., New York, 1969, 165 pp.

Brooks, Carl N. "Training System Evaluation Using Mathematical Models," *Educational Technology*, Vol. IX, No. 6, June 1969, pp. 54-61.

This paper applies mathematical modeling techniques to the predesign evaluation of the performance of an automotive mechanics training system. First, the method of deriving the model will be demonstrated in three stages:

1. derive the flowchart model of the system as it should operate;
2. convert flowchart functions into mathematical form;
3. derive the equations describing the system performance.

Second, the mathematical model will be applied in predicting the system performance. This application demonstrates the economic advantages of using the mathematical modeling approach.--*Auth.*

Brydle, John Robert (Wayne State University). "Analysis of Major Electronics Technician Training Problems Encountered by Leading Electronics Systems Manufacturers in the United States," *Research in Industrial Education, Summary of Studies 1960-1961*, Trade and Industrial Education Series No. 75, Vocational Division Bulletin No. 299, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1962.

The purpose of the study was to collect and analyze the major technical training problems of commercial organizations offering electronics technician training programs.

Information was collected from 50 leading electronics systems manufacturers in the United States.

The ten leading problems revealed by the respondents were:

(1) The students often lack a good foundation in mathematics and basic sciences.

(2) There was not enough time to train instructors in both theoretical and practical aspects of the equipment they taught.

(3) Technical manuals were inadequate for training.

(4) It was difficult to obtain enough laboratory equipment.

(5) There was a shortage of instructors.

(6) There was not enough time to train instructors in teaching techniques.

(7) Better tests of the students' ability to maintain equipment were needed.

(8) Training supervisors were not close enough to training problems, and could not keep up to date on new equipment being taught.

(9) Some students took their work too lightly.

(10) Some instructors needed more field experience on the equipment they taught.--*Auth.*

Caldwell, Lynton K. "Measuring and Evaluating Personnel Training," *Public Personnel Review*, Vol. 25, No. 2, April 1964, pp. 97-102.

"The ultimate test of training is whether it attains its objectives. But it is also important to know whether those objectives and the efforts to achieve them are worthwhile in terms of cost and in relation to the goals and objectives of the government. Because training entails costs and because it substantially affects the performance of the public service, any serious effort to improve the public service through training will make provision for measuring and evaluating training effectiveness... This discussion [by the author] dispels the belief that the impact of training is too complex to measure and that the variables involved defy evaluation." Contents: Establish performance standards; gauge for achievement needed; pitfalls in measuring results; selecting measurement criteria; keep tab on program's value; criteria defining values; avoid noting unstated objectives; and conclusions.--*Auth.*

Coster, John K. and Ihnen, Loren A. "Program Evaluation," Chapter VIII in *Review of Educational Research,* XXXVIII, No. 4., October 1968, pp. 417-433.

Craig, Robert L. and Bittel, Lester R. *Training and Development Handbook,* McGraw-Hill Book Co., New York, 1967, 650 pp.

Foley, John P., Jr. *Performance Testing: Testing for What Is Real,* AMRL Memorandum P-42, 6570th Aerospace Medical Research Laboratories, Aerospace Medical Division, Wright-Patterson AFB, Ohio, June 1963. (AD 412 776)

It is generally conceded that performance examinations are superior to written examinations for the measurement of job behaviors required of Air Force specialists and technicians. However, performance examinations, both in school and on the job, are time consuming in their development and in their administration. Written examinations have, therefore, been substituted in many cases for performance examinations. This memorandum presents the difficulties involved in developing and administering performance examinations, the dangers of depending upon written examinations as substitutes for performance examinations, and the fact that there is a lack of research information on the valid substitution of written for performance examinations. It proposes developmental research with a view of simplifying performance examination procedures and establishing valid guidelines as to the scope of written examinations in measuring job behaviors. It, also, makes some recommendations concerning immediate action that can be taken to improve the validity of current technical training examination procedures.--*Auth.*

Freeberg, Norman E. and Reilly, Richard R. *Development of Guidance Measures for Youth-Work Training Program Enrollees. Phase I: Measurement of Program Objectives and the Development of Criteria,* PR-71-13, prepared for U.S. Department of Labor, Manpower Administration, by Educational Testing Service, Princeton, N.J., July 1971, 152 pp.

Rationally defined outcome variables, for use in evaluating youth-work training programs, were incorporated in questionnaires administered to present and former Neighborhood Youth Corps enrollees and analyzed to determine their suitability as criterion measures. Using a factor analytic technique, empirically defined clusters were obtained for immediately available (end-of-program) outcomes and longer term (post-program) outcomes. The most logical groups of criteria were found for those former enrollees who had full-time employment experience. Relatively clear patterns of job-oriented capability and success were dominant as were two separate factors bearing on personal adjustment to the job and to the community.

Some descriptive highlights concerning the vocational behaviors of former trainees are presented and future research needs for better definition and understanding of program objectives are discussed.--*Auth.*

Glaser, Robert. "Instructional Technology and the Measurement of Learning Outcomes: Some Questions," in Popham, W. James (ed.), *Criterion-Referenced Measurement, An Introduction,* Educational Technology Publications, Englewood Cliffs, N.J., 1971, pp. 5-14. (See also same title, *American Psychologist,* Vol. 18, 1963, pp. 519-521.)

Glaser, R. and Klaus, D.J. "Proficiency Measurement: Assessing Human Performance," in Gagne, R.M. (ed.), *Psychological Principles in System Development,* Holt, Rinehart and Winston, New York, 1962, pp. 419-474.

Glaser, Robert and Nitko, A.J. "Measurement in Learning and Instruction," in Thorndike, R.L. (ed.), *Educational Measurement,* American Council on Education, Washington, D.C., 1971.

Gustafson, Herbert W. *Research on Methods of Evaluating Maintenance Proficiency,* Technical Report AFPTRC-TR-58-6, Air Force Personnel and Training Research Center, January 1958. (AD 152-108)

This Technical Report summarizes briefly the findings of exploratory studies, conducted under Task No. 37303, designed to better the measurement of the performance of maintenance personnel by improving testing procedures and use of information derived from records of job performance. Four separate research efforts were devoted to developing improved performance-testing techniques: (1) preparation of a guidebook on maintenance-performance evaluation; (2) statistical re-analyses of proficiency test data to relate troubleshooting performance to specific kinds of aptitudes and basic knowledge, and to determine the relations among types of errors committed in performing complex alignments and adjustments; (3) development of two microfilm projection devices for use in training troubleshooters and in assessing troubleshooting performance; and (4) a study of the effects of variations in performance-testing procedures. Two studies of maintenance performance records are also reported.--*Auth.*

Hawkridge, David G., Campeau, Peggy L., Weisgerber, Robert A., Manes, Audrey L., Fors, Robert A., and Youngquist, Louise V. *A Study of Selected Programs for Vocational Education in Secondary Schools*, Final Report AIR-848-1/70-FR, prepared for Office of Education, U.S. Department of Health, Education, and Welfare by the American Institutes for Research, Palo Alto, Calif., January 1970, 95 pp. (ED 041 155)

The aims were to identify, select, analyze, and describe vocational programs at the secondary level that had been successful in increasing the total placement rate (employment, further education) when compared with other courses of instruction. Through a literature search, mail and telephone inquiries, personal contacts, and other means, 445 programs were identified for study with emphasis on program evaluation, particularly follow-up of graduates. Some 30 programs were site-visited.

None of the 445 programs could be shown to have met the study's criteria for success; 43% lacked comprehensive follow-up data on graduates; 33% had nearly complete data, but no trends could be detected, nor were suitable comparison groups of nonvocational graduates available.

Even if comparable, contemporaneous groups had existed, and even if complete follow-up of both groups of graduates had been possible, it was concluded that the original criteria needed to be supplemented by criteria that took into account qualitative placement factors, such as initial job earnings, on-the-job competency, job retention, progress within the job, and mobility within a range of jobs related to the training provided by the vocational program.

Recommendations for program design and evaluation that would permit the assessment of such factors conclude the report.--*Auth.*

Jacobs, Paul I., Maier, Milton H., and Stolurow, Lawrence M. *A Guide to Evaluating Self-Instructional Programs*, Holt, Rinehart and Winston, 1966.

Kayloe Alvin G. "A Method for Evaluating the Effectiveness of Technical Training," *Training and Development Journal*, Vol. 25, No. 6, June 1971, pp. 24-30.

Lee, Walter S. "A New Model for Psychological Services in Educational Systems," *Educational Technology*, Vol. XII, No. 6, June 1972, pp. 22-24.

Little, J. Kenneth. *Review and Synthesis of Research on the Placement and Follow-Up of Vocational Education Students*, Information Series, ERIC Clearinghouse on Vocational and Technical Education, The Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, February 1970. (ED 037 543)

Mager, Robert F. and Pipe, Peter. *Analyzing Performance Problems or 'You Really Oughta Wanna'*, Lear Siegler, Inc., Education Division, Fearon Publishers, Belmont, Calif., 1970.

Mobilization for Youth, Inc. *The Work Sample: Reality-Based Assessment of Vocational Potential*, Final Report DLMA-82-34-69-21-4, prepared for U.S. Department of Labor, Manpower Administration, by the Experimental Manpower Laboratory at Mobilization for Youth, Inc., New York, March 1971. (PB 199 474)

The purpose of the handbooks is to serve as a technical guide in establishing work sample programs. The publication is a "how-to" manual for developing appropriate work samples, establishing the vocational evaluation unit, and training vocational evaluators. The objective of the handbook is to aid intended users in assessing the vocational potential of the disadvantaged.--*Auth.*

Moss, Jerome, Jr. and Stromsdorfer, Ernest W. "Evaluating Vocational and Technical Education Programs," in Somers, Gerald G. and Little, Kenneth (eds.), *Vocational Education: Today and Tomorrow*, Center for Studies in Vocational and Technical Education, The University of Wisconsin, Madison, Wisc., 1971, pp. 219-261.

Norton, Robert E., Love, Lamar E., and Rolloff, John A. *Guide to Improving Vocational Education Evaluation*, College of Education, University of Arkansas, Fayetteville, Arkansas, December 1970.

Short-term training institutes represent one of a variety of methods being used to improve the status of vocational education evaluation. In addition to developing leadership competencies needed in evaluation, another purpose of these institutes has been to draw upon the talents of the consultants and participants in order to help develop improved strategies and procedures of evaluation.

In keeping with these purposes, a major part of this guide is concerned with presenting viewpoints on which there was general consensus among the participants attending the National Institute on Improving Vocational Education Evaluation, which was held August 4-8, 1969, at the University of Arkansas. Attention is also given to points and issues on which there seemed to be little agreement among either the consultants or the participants. Finally, some suggestions on how evaluation can be improved are offered.--*Auth.*

Popham, W. James. "Objectives and Instruction," in Popham, W.J., Eisner, E.W., Sullivan, H.J., and Tyler, L.L. *Instructional Objectives*, American Educational Research Association Monograph on Curriculum Evaluation No. 3, Rand McNally, Chicago, 1969, pp. 32-64.

Rafacz, Bernard A. and Foley, Paul P. *Preliminary Results on the Evaluation of a Fleet Post-Training Performance Evaluation Technique*, WTR 73-10, Naval Personnel Research and Development Laboratory, Washington Navy Yard, Washington, D.C., January 1973.

The purpose of this research effort is to validate the utility and effectiveness of a unique human performance measurement technique developed under ONR contract (N0001467C0107). Performance data on eight Navy ratings were collected from ships of LANTFLT and PACFLT. This report is the first in a series of technical reports on the statistical analysis of that data. In particular, a statistical analysis is provided on performance-related data for electronic maintenance personnel sampled from 11 ships of CRUDESFLOT NINE, San Diego, California. Four different performance estimators, as functions of critical incidents, are evaluated with respect to a performance criteria. A detailed explanation of the distributional properties of the performance estimators is presented and an explanation of the factors that lead to the adoption of a curvilinear regression analysis for analysis of the data is discussed.

The results of the statistical analysis indicated that a certain combination of the performance data possessed moderate validity for measuring the absolute level of technician performance. Detailed analysis of the performance data also identified the areas of difficulty that have to be avoided in order to improve upon the validity of each of the performance estimators. These and other preliminary results indicate that the technique possesses merit for further development and research. The Naval Personnel Research and Development Laboratory is continuing research on this technique with respect to the totality of data collected.--*Auth.*

Ratliff, Forrest R., Chiorini, John R., Curran, Charles R., and Shore, C. Wayne. *Evaluating Combat Crew Training Performance Using Criteria of Minimum Performance Standards*, AFHRL-TR-70-50, Personnel Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, November 1970. AD-722 409.

An 11-point rating scale and minimum acceptable performance criteria were developed for each training phase of F-4 combat crew training to measure training progress and compare the performance of two groups of student aircraft commanders. Instructor pilots rated the performance of student aircraft commanders who were either upgrading second-seat crew members or recent undergraduate pilot training (UPT) graduates. The objectives were to determine the effects on performance in combat crew training school of experiences as F-4 second-seat crew members, and to determine whether recent UPT graduates with no experience as second-seat crew members could meet the minimum performance standards of combat crew training in the amount of time currently allotted. The students were rated against the criteria of miminum acceptable performance using standardized rating procedures. Several conclusions were reached on the basis of this study: (a) Proficiency ratings made against criteria of minimum acceptable performance can be used to measure training progress and compare rates of gain in proficiency between two or more groups; (b) experience as F-4 second-seat crew members resulted in higher proficiency ratings at the beginning of most training phases for the upgrading second-seat crew members; (c) recent UPT graduates improved their rated performance to achieve levels of proficiency similar to the upgrading second-seat crew members by the end of most training phases; and (d) students from the top 10% of their UPT classes should be able to successfully complete F-4 combat crew training as aircraft commanders in the amount of time currently alloted without previous exposure to the F-4 as second-seat crew members.--*Auth.*

Rose, Homer C. *The Development and Supervision of Training Programs*, American Technical Society, 1964.

Schultz, Douglas G. and Siegel, Arthur I. *Post-Training Performance Criterion Development and Application: A Selected Review of Methods for Measuring Individual Differences in On-The-Job Performance*, Applied Psychological Services, Wayne, Pa., July 1961.

For several years, Applied Psychological Services has been carrying out research in the development and application of criteria for assessing the proficiency of Naval technicians in various technical specialties. Before undertaking additional work, it seemed wise to evaluate the current state-of-the-art with respect to methods for the measurement of individual differences in on-the-job performance. This report considered recent progress in the area and attempted to point up a number of important issues that require investigation and clarification.

Job performance appraisal techniques that have been used were discussed. These included production records, interviews and questionnaires, work sample and situation tests, appraisal of executive performance, and rating scales. Criterion analysis was reviewed in terms of intercorrelation and factor analysis, scaling, and reliability, including job performance changes over time.

Important current issues in the field of job performance measurement discussed were problems associated with the dimensionality of performance criteria, their selection and evaluation, their predictability, their ultimacy, and the influence of environmental factors.

It was concluded that there is need for an integrating conceptual framework to order and organize the field of measuring individual differences in on-the-job performance and to provide a more satisfactory basis for evaluating on-the-job performance.--*Auth.*

Seagren, P.W. *Evaluation of Vocational-Technical Education Program Effectiveness* (Speech), Division of Vocational Education, University of California at Los Angeles, Calif., 19 August 1969, 12 pp.

Program management techniques were adopted from business and industry in order to provide an efficient and effective program of occupational training. The techniques include: (1) loss of tools or damage reports, (2) check-in system for instructors, (3) trainee attendance control (4) use of facilities, (5) organizational structure, (6) instructor evaluation, (7) production requests, (8) curricular standards, (9) cost effectiveness, (10) advisory committees, and (11) accreditation.--*C.H.*

Siegel, Arthur I., Schultz, Douglas G., and Federman, Philip. *Post-Training Performance Criterion Development and Application: A Matrix Method for the Evaluation of Training*, prepared for Personnel and Training Branch, Office of Naval Research, by Applied Psychological Services, Wayne, Pa., January 1961.

This report demonstrates the use of "suitability" for the job as a basis for training evaluation by: (1) describing a specific scheme for quantitatively summarizing suitability, and (2) illustrating the application of the scheme through data collected in previous Applied Psychological Services' studies of four naval ratings. "Suitability" for the job is defined as the training graduates' ability to do the tasks involved in the job.

Matrix solutions are described that yield three indices, each reflecting a different aspect of the comparison between the skills of the trained man and the job's requirements. The method avoids the necessity for the determination of the functional relationship between training emphasis and job proficiency. Listing of the tasks as they are classified in the cells of a matrix and as they thereby contribute to the various training indices provides a further basis for consideration of specific changes in emphasis in various parts of the training program. The characteristics and limitations of the method are discussed and the results of its application to four naval ratings presented.--*Auth.*

Stufflebeam, Daniel L. "Toward a Science of Educational Evaluation," *Educational Technology*, Vol. 8, No. 14, 1968, pp. 5-12.

Suchman, Edward A. *Evaluative Research: Principles and Practice in Public Service and Social Action Programs*, Russell Sage Foundation, New York, 1967, 186 pp.

Edward A. Suchman, one of the world's foremost experts in measuring social behavior, presents the most comprehensive study of evaluation available to date. In this report he describes the techniques used to determine empirically the extent to which social goals are actually being achieved, to locate the barriers to the achievement of these goals, and to discover the unanticipated consequences of social actions.

This book will have many uses. It will aid the evaluative research person in striking a balance between rigorous method and the situation in which he must function. For the operating practitioner, the book will explain what competent evaluation involves. Administrators will find the volume an invaluable aid.--*Auth.*

Sullivan, Howard J. "Objectives, Evaluation, and Improved Learner Achievement," in Popham, W.J., Eisner, E.W., Sullivan, H.J., and Tyler, L.L., *Instructional Objectives*, American Educational Research Association Monograph on Curriculum Evaluation No. 3, Rand McNally, Chicago, 1969, pp. 65-99.

Tracey, William R. *Evaluating Training and Development Systems*, American Management Association, Inc., 1968, 304 pp.

This practical workbook will help every training manager evaluate and improve his company's instructional program to achieve maximum returns on investments in time, effort, and money. This book provides more than two hundred detailed analysis sheets that show the training director how to examine, evaluate, and revise each aspect of his program. Applicable for every type of training program--from nonexempt through supervisory to managerial--these checklists enable him to plan and organize training activities geared to the needs of his company.

Here are specific evaluation criteria and detailed suggestions for using them. This helpful guide shows how to:

- identify strengths and critical weaknesses in existing programs
- devise procedures to improve the system
- determine the resources required for training

- initiate appropriate control devices

- evaluate the instructor--his appearance and speech, his techniques, his ability to evoke student participation

Informed, cost-conscious training directors will welcome this book as an invaluable aid in setting up and improving training programs that will produce more profitable results.--*Auth.*

Ullery, J. William. *Project ABLE, Development and Evaluation of an Experimental Curriculum for the New Quincy (Mass.) Vocational-Technical School. Management and Evaluation Plan for Instructional Systems Development for Vocational-Technical Education,* Technical Report 15, American Institutes for Research, Pittsburgh, Pa., and Quincy Public Schools, Quincy, Mass., April 1970.

U.S. Department of the Navy. *Fundamentals of Navy Curriculum Planning,* NAVPERS 93510-1, Bureau of Naval Personnel, Washington, D.C., October 1968.

This publication is one of a new series of education and training manuals to be published by the Bureau of Naval Personnel. When completed, the series (NAVPERS 93510) will encompass all elements of instructional technology, course design, and school management and administration appropriate to Navy education and training. The first of the series to be distributed to Navy training activities and schools is the Handbook for Writing Learning Objectives, NAVPERS 93510-2, which should be studied by school administrators and instructors as an adjunct to this publication.

The "instructional systems engineering approach" (or "systems approach") to course planning and design is emphasized in this publication along with its application to the development of curriculum documentation for use in Navy schools.

Other publications planned for this integrated series will include revised manuals on testing and evaluation, school administration, instructor training, in-service training, and new manuals on subjects such as utilization of instructional television and programmed instruction.

Warren, Malcolm W. "Evaluating Training Actions," Chapter 8 in *Training for Results: A Systems Approach to the Development of Human Resources in Industry,* Addison-Wesley, Reading, Mass., 1969, pp. 112-130.

Webb, Eugene J., Campbell, Donald T., Schwartz, Richard D., and Sechrest, Lee. *Unobstrusive Measures: Nonreactive Research in the Social Sciences*, Rand McNally & Co., Chicago, Ill., 1966, 225 pp.

Wheeler, E. A. "Economic Considerations for Industrial Training: A Study of Criteria for Controlling Training Costs," *Training and Development Journal*, Vol. 23, No. 1, January 1969, pp. 14-18.

Wolman, Jean M., Campbell, Vincent N., Jung, Steven M., and Richards, James M. *A Comparative Study of Proprietary and Non-Proprietary Vocational Training Programs--Volume I*, Final Report AIR-22300-11/72-FR, prepared for Office of Education, U.S. Department of Health, Education and Welfare by the American Institutes for Research, Palo Alto, Calif., November 1972.

In order to formulate policy decisions regarding post-secondary vocational education more adequately, the U.S. Office of Education contracted with AIR to perform a survey of proprietary and non-proprietary vocational training programs in four selected occupational areas (office, health, computer, technical) and four metropolitan areas of the U.S. (Atlanta, Chicago, Rochester, San Francisco). The survey was oriented around three broad questions: 1) What are proprietary schools like, and how do they compare with non-proprietary schools offering similar training programs? 2) What are the students like who go to proprietary schools, and how do they compare to students who attend non-proprietary vocational schools? 3) What do students gain as a result of attending proprietary schools, and how do their gains compare to the gains recorded by students who attend non-proprietary schools?

As part of the study, a brief review of the literature was prepared. Structured interviews and questionnaires were developed to survey the institutions, their students, and their alumni. All instruments were pilot-tested and revised as a result. Student questionnaires were administered by school staff members. Alumni questionnaires were mailed, with follow-up reminders. A telephone study of 500 non-responding alumni (77% of whom were reached) revealed no marked differences from earlier respondents. All questionnaires were scored by National Computer Systems.--*Auth.*

Wolman, Jean M., Campbell, Vincent N., Jung, Steven M., and Richards, James M. *A Comparative Study of Proprietary and Non-Proprietary Vocational Training Programs--Volume II: Appendices*, Final Report AIR-22300-11/72-FR, prepared for Office of Education, U.S. Department of Health, Education, and Welfare by the American Institutes for Research, Palo Alto, Calif., November 1972.

SECTION IX

MILITARY DOCUMENTS

Each branch of the service has its own set of regulations governing OJT--but the review of military documents was not restricted to regulations. Many closely related documents and manuals must be considered in order to understand how OJT is actually conducted and how it interfaces with other personnel subsystems. In the Army, for example, it is not possible to understand the OJT system without saying something about the relationship to resident schools programs, unit training programs, proficiency testing programs, and so forth.

A brief description of the OJT program for each branch of the service in the United States is contained in another report in this series (Stephenson and Burkett, 1975).[8] This section lists the most important references for the Department of Defense and each of the services (listed alphabetically).

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[8] See page 4 of this report.

DOD Directive 1304.14, 3 September 1970, subj: "Award of Variable Reenlistment Bonus and Proficiency Pay for Enlisted Personnel." ASD(M&RA)

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SECTION X

INNOVATIONS

As the senior author reviewed the literature, some references attracted his attention in the sense that they suggested possible changes in Air Force policies and procedures. The idea, whatever it was, was written immediately and attached to the reference. Approximately 80 of these "innovation" citations, based upon 40 ideas, were identified.

A list of innovations was prepared and many of them were discussed during the headquarters and field-activity visits (described in Stephenson and Burkett, 1975).[9] Some of the ideas did not survive criticism. Others were found worthy of further review.

Since the literature review was frankly action and decision-oriented, it was not considered adequate to simply list various references next to the ideas with which they were associated. Instead, one-page action-oriented summaries of what was involved in each idea were prepared for each possible innovation. A problem was briefly defined, the proposed solution was described, advantages were listed, and resource requirements were estimated. The literature review thus took on decision-oriented aspects that went far beyond the references themselves.

The list of possible innovations was organized into nine subject-matter categories:

Administrative
Audiovisual Presentations
Computer-Assisted Techniques
Evaluation
Incentives-Motivation of Trainees
Instructional Techniques
Periodic Surveys
Program Design
Other

Each innovation is described and presented here. Additional ideas (inspired by field-activity visits and the analysis of survey data) are contained in Stephenson and Burkett (1975).

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[9] See page 4, this report.

ADMINISTRATIVE

INNOVATION Redefine Objectives for Remedial Programs and Reading Improvement Training

PROBLEM Most remedial reading programs are now administered at field-activity locations. Trainee progress is delayed, because time must be spent away from the job to participate in the reading program. Upgrade training and work performance suffer as a result of these trainees who cannot read the materials required to perform their jobs. Present reading improvement programs are not standardized across commands, and the training is often contracted out to local school disctricts. Objectives of these programs are not always realistic, in that they attempt to improve general rather than job-related reading skills.

SOLUTION Redefine objectives for remedial reading programs by adopting a functional literacy approach designed to develop required minimum job reading skills. These job reading programs should be built around clusters of related specialties having a high incidence of problem readers.

ADVANTAGES More effectiveness in improving needed job-specific reading skills; remedial objectives which are more realistic and attainable; cost-effectiveness associated with a standardized program geared to job and OJT requirements.

RESOURCE REQUIREMENTS It is estimated that 10% of the trainees need such training, and that the average training time required is four to twelve weeks. Program development costs are estimated to be about 3 man-years for the minimal clusters required.

COMMENT It is necessary to define Air Force objectives for reading programs very carefully. One should not expect to solve, in a short time, those individual general literacy problems that community school programs have been unable to solve in years of education. The more limited objective of improving job-related reading skills appears to be more realistic and cost-effective.

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Sticht, Thomas G. (Principal Investigator) and Caylor, J. S. (Associate Investigator). "Development of Prototype Job-Functional Army Literacy Training Program (FLIT)," in *Work Unit Summaries*, Defense Documentation Center, Defense Supply Agency, Alexandria, Va., DDC Report No. CT9150, 22 August 1972, p. 19. (Performing Organization: Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif.; Contract No. DAHC19-70-C-0012.)

Sticht, Thomas G. (Ed.). *Reading for Working: A Functional Literacy Anthology*, Human Resources Research Organization, Alexandria, Va., 1975.

Sticht, Thomas G., et al. *HumRRO's Literacy Research for the U.S. Army: Developing Functional Literacy Training*, HumRRO Professional Paper 13-17, Human Resources Research Organization, Alexandria, Va., December 1973.

This paper summarizes literacy research and development performed by HumRRO for the Army since 1968. Literacy needs for several basic Army Military Occupational Specialties (MOSs) were identified and methodology was developed to evaluate reading requirements for Army jobs. Under the current effort, an experimental training program is being designed to produce a level of functional literacy appropriate to minimal MOS requirements.--*Auth.*

Vineberg, Robert, Sticht, Thomas G., Taylor, Elaine, and Caylor, John S. *Effects of Aptitude (AFQT), Job Experience, and Literacy on Job Performance: Summary of HumRRO Work Units UTILITY and REALISTIC*, HumRRO Technical Report 71-1, Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif., February 1971.

(For abstract see p. 124.)

ADMINISTRATIVE

INNOVATION Rotation Plans for Selected Specialties When the Variety of Training at One Work Center Is Inadequate

PROBLEM Circumstances such as the variety of training available at a given location and unusual production pressures often restrict the training that is available to trainees. These restrictions are acceptable in the dual-training concept, since it is possible to be upgraded based upon learning a single task in a specialty. If this requirement is changed (as suggested in another innovation in this list), some kind of rotation plan must be formally implemented.

SOLUTION Require rotation plans, when the variety of training that is available at a given work center is not adequate to meet minimum needs; these plans should be flexible (e.g., three tasks out of a list of ten must be learned) for selected specialties.

ADVANTAGES Personnel in a specialty would be qualified to perform a reasonable variety of tasks before being upgraded. Morale problems because of an inadquate variety of training tasks would be less likely to occur.

RESOURCE REQUIREMENTS Once the flexible, minimum standards have been determined and the Specialty Training Standard (STS) has been modified, the time required to establish a rotation plan is relatively trivial--a committee of NCOs might have to meet once every six months for a few hours.

SELECTED REFERENCES Christal, Raymond E. (Principal Investigator). "Procedures for Optimal Career Development and Talent Utilization," in *Work Unit Summaries*, Defense Documentation Center, Defense Supply Agency, Alexandria, Va., DDC Report No. CT9150, 22 August 1972, p. 61. (Performing Organization: Air Force Human Resources Laboratory, Lackland AFB, Texas.)

Tuttle, T. C. (Principal Investigator). "Development of Improved Air Force Assignment Systems," in *Work Unit Summaries*, Defense Documentation Center, Defense Supply Agency, Alexandria, Va., DDC Report No. CT9150, 22 August 1972, p. 62. (Performing Organization: Air Force Human Resources Laboratory, Lackland AFB, Texas.)

U.S. Department of Labor, Manpower Administration. *Toward the Ideal Journeyman. Volume 1. An Optimum Training System in Apprenticeable Occupations*, Manpower Research Monograph No. 20, Manpower Administration, Washington, D.C., 1970.

ADMINISTRATIVE

INNOVATION Periodic Comparisons of Technical School and OJT Graduates in Order to Facilitate Decisions About Cost Effective Combination of Technical School and OJT for Category B Specialties

PROBLEM Category B (semiskilled) specialties in the Air Force can be taught either in school or on the job (OJT). Cost factors determine the number who only receive OJT. The decisions are difficult to make, since some of the costs are difficult to quantify, and no one model has been found acceptable by everyone. The situation is further complicated, because studies of the relative costs of OJT and formal schools training have produced inconsistent results; and the policies are somewhat controversial within the Air Force.

SOLUTION Studies comparing OJT graduates and technical school graduates with respect to the time required after basic training before the 5-level is awarded can be conducted on a regular basis. If the advantage is in favor of the OJT graduates, more use of OJT can be recommended; if it favors the technical school graduates, less use of OJT can be recommended.

ADVANTAGES Cost savings associated with improved decisions about the combination of OJT and resident school training (e.g., shorter training time for upgrade trainees).

RESOURCE REQUIREMENTS Reports of this type could be periodically provided for all Category B specialties. Approximately one man-year of effort would be required.

COMMENT Time to complete upgrade training is not so reliable an index as one would hope. The basic problem is that almost everyone finishes upgrade training in the minimum amount of time. The problem is complicated by the procedures by which personnel are selected for OJT and how they vary from specialty to specialty. Nevertheless, the information should be considered, when decisions are being made about an optimum combination of OJT and resident school training.

SELECTED REFERENCES Black, D. and Bottenberg, R. A. *Comparison of Technical School and On-The-Job Training as Methods of*

Skill Upgrading, AFHRL-TR-70-48, Personnel Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, December 1970. (AD 726 530)

(For abstract, see Section V, References.)

ADMINISTRATIVE

INNOVATION	Decision Tables to Facilitate Decisions About When Someone Should be Decertified in a Previously Learned Skill Because of Degradation of Performance
PROBLEM	The decision as to whether someone should be decertified in a certain STS category is difficult to make. If people are decertified unnecessarily, there is much wasted time, while such persons retrace their steps to learn the task. If people who should be decertified are not decertified, there is a real danger of accidents that could damage personnel or equipment.
SOLUTION	Design decision tables that will facilitate decisions as regards when someone should be decertified in a previously learned skill.
ADVANTAGES	Additional guidance to those who must make decisions as regards people being qualified or not; improved job performance and safety.
RESOURCE REQUIREMENTS	Research is needed to design and evaluate ways of predicting degradation of performance, and to develop a decision table that would have proven utility. More research would then be needed to field test the effectiveness of the decision tables before they could be incorporated into Air Force manuals.
SELECTED REFERENCES	Sitterley, T. E. and Berge, W. A. (The Boeing Company, Seattle, Washington). *Degradation of Learned Skills: Effectiveness of Practice Methods on Simulated Space Flight Skill Retention*, Report D180-15081-1, prepared for Manned Spacecraft Center, National Aeronautics and Space Administration, July 1972. Manual flight control and emergency procedure task skill degradation was evaluated after time intervals of from one to six months. The tasks were associated with a simulated launch through orbit insertion flightphase of a space vehicle. The results showed that acceptable flight-control performance was retained for two months, rapidly deteriorating thereafter by a factor of 1.7 to 3.1 depending on the performance measure used. Procedural task performance showed unacceptable degradation after only one month, and exceeded an order of magnitude after four months. The effectiveness of static rehearsal (checklists and briefings) and dynamic warm-up

(simulator practice) retraining methods were compared for the two tasks. In general, static rehearsal effectively countered procedural skill degradation while some combination of dynamic warm-up appeared necessary for flight-control skill retention. Further, it was apparent that these differences between methods were not solely a function of task type or retraining method, but were a function of the performance measures used for each task.--*Auth.*

AUDIOVISUAL PRESENTATIONS

INNOVATION	Conversion of Selected CDCs Into Self-Paced Slide-Tape or Cassette-Film Presentations
PROBLEM	Marginal readers in some career fields have considerable difficulty completing conventional CDCs.
SOLUTION	Slide-tape cassettes are available and can be operated by inserting a single cartridge into an automatic slide-tape playing console about the size of a *small* TV set. When removed, the cartridge rewinds itself and is ready for the next user. Many programs of this type have been found to be effective with marginal readers because they use audio visual techniques to reduce reading demands.
ADVANTAGES	Greater interest on the part of trainees; more effective use of training time; improved visualization of equipment and procedures.
RESOURCE REQUIREMENTS	Cassette film tapes cost approximately $80 apiece. The viewing and playback apparatus cost approximately $400 apiece.
COMMENT	The expense of using this type of equipment could be justified only under circumstances where equipment, personnel, or procedures require extensive visualization.
SELECTED REFERENCES	Baker, G.E. "Experiment in Teaching One-Point Perspective," *Industrial Arts and Vocational Education*, Vol. 45, May 1966, pp. 46-47. Burnap, E.G. "On-The-Job Instruction with Programmed Tapes," *Training Directors Journal*, Vol. 19, No. 10, 1965, pp. 42-48. Crowder, Gene A. "Visual Slides and Assembly Models Compared With Conventional Methods in Teaching Industrial Arts" (Doctoral thesis), Texas A&M University, College Station, Texas, 1968. Flug, Eugene R. F. "An Experimental Evaluation of Selected Presentation Modes in the Self-Instruction of a Manipulative Industrial Arts Learning Task," (Doctoral thesis), University of Minnesota, Minneapolis, 1967. This report summarily describes a study to evaluate the utilization of inflight audio-video recording (AVR) and ground playback equipment in the United States Air Force

T-37 Pilot Instructor Training (PIT) Program. It includes a description of the preparation for, and conduct of, a demonstration designed to permit comparisons between Instructor Pilot (IP) trainees who used the AVR system during their training (TV group) and those who did not (non-TV group). The design included the development and use of (a) special grading sheets for recording evaluations of IP trainee pilot and instructional performance on six maneuvers; (b) a special check-ride to provide additional information on the capability of a graduating trainee to analyze pilot performance errors and apply the principles of instruction in presenting corrective measures to Undergraduate Pilot Training (UPT) students; and (c) a questionnaire designed to solicit effective and ineffective instructional situations encountered by new and experienced UPT IPs. Operational considerations limited the conduct of the study as originally designed, resulting in a less than ideal number of subjects receiving the TV treatment. The results are described in terms of (a) the differences in performance levels between the TV and non-TV group of trainees (no difference), (b) an analysis of the attitudinal comments made by the IPs and IP trainees who used the AVR system regarding its application as a training aid (favorable and enthusiastic), (c) suggested changes to the hardware design of the system, and (d) recommendations for system procurement and implementation into the PIT program and other pilot training programs (conditionally recommended). --*Auth.*

Horner, W.R. and Shettel, H.H. *Audio/Video Recording in Pilot Instructor Training,* Flying Training Division, Air Force Human Resources Laboratory, Williams AFB, Arizona, February 1972.

Moeller, C.A. "A Comparison of Selected Audio-Visual Methods and Lecture Demonstration Methods in Teaching Manipulative Skills Related to Metal Operations," *Journal of Industrial Teacher Education,* Vol. 4, March 1967, pp. 20-29.

North, Stafford (Oklahoma Christian College). "Ivy Walls, Tapes, and Workbooks," in *Papers Presented at a Symposium on Programmed Learning Systems,* held at the Christopher Inn, Columbus, Ohio, 18 May 1965, sponsored by North Electric Co., Galion, Ohio.

Pieper, W.J., Catrow, E.J., and Swezey, R.W. (Applied Science Associates, Inc.), and Smith, E.A. (Air Force Human Resources Laboratory, Lowry AFB, Colo.). "Automated Apprenticeship Training (AAT): A Systematized Audiovisual Approach to Self-Paced Job Training," *Catalog of Selected Documents in Psychology*, a publication of the Journal Supplement Abstract Service (MS No. 315), Vol. 3, Winter 1973, p. 21. *(See also* Air Force Human Resources Laboratory Technical Report, AFHRL-TR-72-20.)

Two Automated Apprenticeship Training (AAT) courses were developed, administered, and evaluated for Air Force Security Police Law Enforcement and Security specialists. AAT is a systematized audio-visual approach to self-paced job training which employs an easily operated, portable and reliable teaching device. AAT courses were developed to be job specific and were based on a behavioral task analysis of the two Security Police specialty areas. AAT graduates were compared with graduates of comparable Airman Basic Resident (ABR) course and Career Development Course (CDC) for the same jobs in a Training Regime by Aptitude Group design. Evaluation criteria included a job specific performance test, an apprentice knowledge test and supervisor's ratings. Results indicated superior scores for the AAT graduates on the job performance test, and no differences among Training Regimes on the other criteria. A significant Aptitude effect was also obtained on the job performance test. The AAT Course was considered superior to other Training Regimes in terms of man-hours expended. Training supervisors also expressed a preference for the AAT technique. *--Auth.*

Scharf, George P. "Modified Fire Protection Specialist Career Development Course for New Mental Standards Personnel," paper presented at the 15th Annual Conference, Military Testing Association, held in San Antonio, Texas, 28 October-2 November 1973.

AUDIOVISUAL PRESENTATIONS

INNOVATION	Learning by Listening
PROBLEM	Some Air Force personnel are functionally illiterate, but they can understand the spoken word relatively well. Tape recordings of lessons seem to work better for such people than do CDC volumes.
SOLUTION	Tape-record CDCs and make them available to personnel in selected specialties who prefer or need such a mode of instruction.
ADVANTAGES	Air Force personnel who have difficulty reading can still make progress in their CDCs; Air Force personnel who prefer to listen rather than read can do so.
RESOURCE REQUIREMENTS	The least expensive method is to simply tape-record the text, and send the text along with the cassette to those who prefer to read and listen.
COMMENT	Control of tape recorders is likely to be a problem.
SELECTED REFERENCES	Curran, Thomas E. (Navy Training Research Laboratory) and Brock, John F. (Fleet Anti-Air Warfare Training Center). *Programmed Instruction for Selected CIC Watch Officer Tasks: I. An Experimental Evaluation of the Audio Notebook in the Teaching of Radiotelephone,* SRR 68-11, U.S. Naval Personnel Research Activity, San Diego, Calif., November 1967. (AD 664 235) Scharf, George P. "Modified Fire Protection Specialist Career Development Course for New Mental Standards Personnel," paper presented at the 15th Annual Conference, Military Testing Association, held in San Antonio, Texas, 28 October-2 November 1973. Sticht, Thomas G. *Learning by Listening in Relation to Aptitude, Reading, and Rate-Controlled Speech,* HumRRO Technical Report 69-23, Human Resources Research Organization, Division No. 3, Presidio of Monterey, Calif., December 1969. A series of studies was performed to explore the possibility of substituting listening for reading requirements, with special reference to marginally literate Category IV personnel. Time-compressed speech was evaluated as a means of producing listening rates comparable

to silent reading rates. The results indicated that for both average and low aptitude men, listening was as effective as reading for obtaining factual information from test passages varying in difficulty level. Both high and low aptitude men performed more efficiently with moderate (36%) amounts of time compression than with no compression of the listening selections. Additional evaluations of time-compressed speech were made, and education and training implications of the research were discussed.--*Auth.*

Sticht, Thomas G. *Learning by Listening in Relation to Aptitude, Reading and Rate-Controlled Speech: Additional Studies,* HumRRO Technical Report 71-5, Human Resources Research Organization, Division No.3, Presidio of Montery, Calif., April 1971.

A series of experiments explored the feasibility of substituting listening for reading requirements in Army training and jobs, with special reference to marginally literate, AFQT Mental Category IV men. Results of these experiments and related earlier research are summarized. Major findings indicate that high and low aptitude men may learn certain materials as well by listening as by reading; some poorer readers prefer to learn by listening rather than by reading. Characteristics of the recorded message that were found to affect listening comprehension include difficulty level of message, linguistic features of speech, and rate of speech. Extensive studies of the use of time-compressed and expanded recordings are described.--*Auth.*

AUDIOVISUAL PRESENTATIONS

INNOVATION Decision Flow Charts for Selecting Communications Media

PROBLEM There are so many different media, and so many fads in training program design, that it is difficult to decide which media would be best under which circumstances.

SOLUTION Decision flow charts for selecting communications media for each part of the training process and for different kinds of training programs.

ADVANTAGES Expert decisions about communications media can be made quickly by personnel who are not well-read in the field.

RESOURCE REQUIREMENTS Some decision tables have already been designed, but they have not been widely dispersed to training designers. The use of these decision tables needs to be evaluated, and revised decision tables need to be designed.

SELECTED REFERENCES Bretz, R. *The Selection of Appropriate Communications Media for Instruction: A Guide for Designers of Air Force Technical Training Programs*, Rand Report R-601-PR, Rand, Santa Monica, Calif., February 1971.

This report presents a description and discussion of the uses of communication media of all classes in instruction. Communication media are systems that transmit messages for larger user systems which serve such purposes as instruction, information, entertainment, or propaganda dissemination. The function of a communication medium is simply to communicate, and this function is the focus of this Report. No attempt is made to consider the values of communication, its results, or its effectiveness, as any such evaluation must be done in the specific context of the system being served by the communication medium.

Eleven uses for communication in instruction are described, each of which has distinct requirements in terms of communication media, equipment configurations, and program content:

(1) Providing the learner with knowledge of his learning objectives;
(2) Motivating the learner;
(3) Presenting information;
(4) Stimulating discussion;
(5) Directing learner activities;
(6) Conducting drill and practice;
(7) Reinforcing learning;
(8) Providing a learner/simulator interface;
(9) Evaluating learner progress and program effectiveness;
(10) Assisting in the administration of instructional systems; and
(11) Assisting in research and development.

The selection of the appropriate media for each of these uses is discussed, and criteria are given for determining the need for various system capabilities in illustrative instructional situations.--*Auth.*

COMPUTER ASSISTED TECHNIQUES

INNOVATION Computer Assisted Text Handling Systems for Rapid Revisions of CDC Volumes

PROBLEM A complaint about CDCs is that some of them are out of date. One reason is that relatively minor revisions and changes could require retyping, editing, and proofreading of whole volumes.

SOLUTION Put CDC volumes on tapes, and let one of the recently developed text-handling subsystems make corrections and produce master printouts suitable for printing.

ADVANTAGES More rapid updating of CDC volumes.

RESOURCE REQUIREMENTS It takes much longer and is more expensive to get text on the computer initially; but the costs of rewriting and editing are much less after the initial investment.

SELECTED REFERENCES Caylor, John S., Sticht, Thomas G., Fox, Lynn, and Ford, J. Patrick. *Methodology for Evaluating Reading Requirements of Army Jobs*, HumRRO Technical Report 73-5, Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif., March 1973.

IMPACT Staff. *Project IMPACT--Computer-Administered Instruction: Description of the Hardware/Software Subsystem*, HumRRO Technical Report 70-22, Human Resources Research Organization, HumRRO Division No. 1, Alexandria, Va., December 1970.

IMPACT Staff. *Project IMPACT--Computer-Administered Instruction: Preparing and Managing the Content of Instruction, IMPACT Text-Handling Subsystem*, HumRRO Technical Report 71-21, Human Resources Research Organization, HumRRO Division No. 1, Alexandria, Va., September 1971.

Project IMPACT is a comprehensive advanced development project designed to produce an effective and economical computer-administered instruction (CAI) system for the Army. This report describes the concepts, approach, and implementation of the Project IMPACT text-handling subsystem. The computer-based facilities for preparing, storing, and retrieving the content of CAI courses of instruction are described, as are CAI courses. Computer software tools are described in terms of their use by course authors.--*Auth.*

Vineberg, Robert, Sticht, Thomas G., Taylor, Elaine, and Taylor, John S. *Effects of Aptitude (AFQT), Job Experience, and Literacy on Job Performance: Summary of HumRRO Work Units UTILITY and REALISTIC*, HumRRO Technical Report 71-1, Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif., February 1971.

A series of studies were conducted to determine how Army personnel in Mental Category IV and in other mental categories compare in their job performance and in their overall suitability for military service. Information is provided concerning the demands for reading, arithmetic, and listening skills in four major military occupational specialties. The performance of approximately 1800 men with Army experience ranging up to 20 years was measured by intensive job sample tests, job knowledge tests, and supervisor ratings. Information about background, personal characteristics, and military experiences was obtained through biographical questionnaires, a battery of published and experimental tests, and Army records. The major findings and conclusions are given in this summary report, which will be followed by several detailed reports on various research phases.--*Auth.*

COMPUTER ASSISTED TECHNIQUES

INNOVATION Screen End-of-Course Examinations and Specialty Knowledge Tests (SKTs) for Reading Level by Using Computerized Reading-Level Evaluation Procedures

PROBLEM The language in which a test is written can make it unnecessarily difficult to pass for someone who is a member of an underprivileged minority. Long words, or words that one is not likely to encounter unless one is part of the American middle class, sometimes get into EOCs and SKTs. As a result, some training examinations seem to resemble vocabulary tests more than they resemble tests of job knowledge.

SOLUTION Procedures are being designed by which a computer can quickly indicate the reading level of sample test items. The items are keypunched on cards, and submitted to the computer for analysis. The computer determines word and sentence length, checks the word frequency in the population at large, and provides a set of reading-level scores. Cutting scores would prohibit the items from being used, if the scores fell below certain points.

ADVANTAGES Fairness in tests; and improved equity in decisions based upon the test performance.

RESOURCE REQUIREMENTS Special procedures would be needed for dealing with technical jargon before any automated reading-level index could be used. The development of these procedures requires further research. Once the procedures have been designed, however, resource requirements (keypunching, computer time) would be minimal.

SELECTED REFERENCES

Caylor, John S., Sticht, Thomas G., Fox, Lynn, and Ford, J. Patrick. *Methodology for Evaluating Reading Requirements of Army Jobs*, HumRRO Technical Report 73-5, Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif., March 1973.

Van Doren, R. (ed.). "Bread and Fire: Manpower, Human Assessment and the Disadvantaged," *American Vocational Journal*, Vol. 48, No. 1, 1973, pp. 85-100.

Vineberg, Robert, Sticht, Thomas G., Taylor, Elaine, and Caylor, John S. *Effects of Aptitude (AFQT), Job Experience, and Literacy on Job Performance: Summary of HumRRO Work Units UTILITY and REALISTIC*, HumRRO Technical Report 71-1, Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif., February 1971.

COMPUTER ASSISTED TECHNIQUES

INNOVATION	Computer-Assisted Item Writing and Test Assembly Procedures
PROBLEM	CDC end-of-course tests must be available in several different versions, and must be revised periodically. Otherwise, the test content would become generally known, and personnel who have already taken a test could be in a position to help others to be prepared for it.
SOLUTION	Computer-assisted item writing, techniques based upon text scanning procedures, and test assembly procedures based upon a common pool of items that are categorized by subject matter area for rapid updating and revision.
ADVANTAGES	Test development should be more economical once a satisfactory set of procedures has been developed. There would be more tests available at less cost.
RESOURCE REQUIREMENTS	It is relatively easy to set up a computer-assisted test assembly technique, but a generally useful set of item-writing techniques has not yet been developed. The initial resource requirements for computerized test assembly techniques are estimated at one man-month per test, but savings in test development costs should more than compensate for this expense. Research and development costs for a satisfactory item-writing technique are estimated at five man-years.
SELECTED REFERENCES	Anastasio, E.J., et al. *Computer-Assisted Item Writing--II. Sentence Completion Items*, TDM-69-1, Educational Testing Services, Princeton, N.J., 1969. Carver, Ronald P. *Procedures for Constructing a Variety of Information Processing Measures Appropriate for Production Materials*, Revrac Publications, Silver Spring, Md., 1971. Finucane, J.L. *Item Banks: Developing Evaluation Tests--Automated Process (DETAP)*, Technical Memorandum 34, U.S. Army Enlisted Evaluation Center, Indianapolis, Indiana, May 1970.

EVALUATION

INNOVATION	Use of Trainee Confidence Ratings as a Diagnostic Aid for Evaluating Progress in Training
PROBLEM	Very little guidance is provided to OJT supervisor/trainers regarding how they should go about evaluating the hands-on performance of OJT trainees in order to decide whether they are really qualified to perform a task. As a result, some trainees are undertrained and others are overtrained.
SOLUTION	Have the trainee rate his confidence in his ability to perform each task on his JPG before the supervisor/trainer certifies that his training is completed. Permit the trainee to indicate whether he considers himself to be undertrained or overtrained in each category of training. File this information in his training record until a new JPG is prepared.
ADVANTAGES	More informed and more accurate evaluations of progress in training.
RESOURCE REQUIREMENTS	Some new forms would have to be designed. A field test is needed before the procedures could be adopted.
COMMENT	Personality factors (self-confidence) complicate the confidence ratings, as well as the overtraining and undertraining ratings. One can also argue, however, that the trainee who lacks confidence should be given more training than one who does not.
SELECTED REFERENCES	Echternacht, Gary J. *Use of Confidence Testing in Objective Tests*, AFHRL-TR-71-32, Technical Training Division, Air Force Human Resources Laboratory, Lowry AFB, Colo., July 1971. AD-734 031. The development of confidence testing as a form of objective testing was traced from Hevner's initial format to that developed in recent years. Confidence testing has been used in varying forms over the past forty years as a method for increasing the amount of information available from objective test items. This paper traces the development of the procedure from Hevner's beginning method up to the various methods in use today. The term confidence testing is applied to both probabilistic testing and confidence weighting procedures. Various procedures are presented, and their relationship with personality factors is discussed.--*Auth.*

Echternacht, Gary J., Boldt, Robert F., and Sellman, Wayne S. *User's Handbook for Confidence Testing as a Diagnostic Aid in Technical Training*, AFHRL-TR-71-34, Technical Training Division, Air Force Human Resources Laboratory, Lowry AFB, Colo., July 1971. AD-731 192.

This handbook is intended to supply both testing specialists and general users of tests with a set of instructions for implementing a program of confidence testing in technical training situations, provide information concerning such factors as the identification of promising areas of application, the relative value and ease of alternative scoring methods, techniques for evaluating confidence information, and administrative considerations. It contains a discussion of Pick-One and Distribute 100 Points confidence formats, other confidence procedures, and the relative merits of each method, selection and confidence test scale scores, uses of confidence testing, and instructions for those administering confidence tests where either hand or machine scoring is used.--*Auth.*

Echternacht, Gary J., Sellman, Wayne S., Boldt, Robert F., and Young, Joseph D. *An Evaluation of the Feasibility of Confidence Testing as a Diagnostic Aid in Technical Training*, AFHRL-TR-71-33, Technical Training Division, Air Force Human Resources Laboratory, Lowry AFB, Colo., July 1971. AD-734 032.

This report describes a study to determine the feasibility and the cost-effectiveness of using confidence testing as a diagnostic aid in technical training programs. Two types of confidence testing, Pick-One and Distribute 100 Points, were developed for comparison to conventional multiple-choice testing. The study was carried out in two technical training courses, Aerospace Ground Equipment Repairman (AGE) and Jet Engine Mechanic (JEM), currently being taught at Chanute Air Force Base, Illinois. The criteria for feasibility included end of block examination grades, number of student remediational sessions, and both student and instructor attitudes. In addition, the relationship of various personality variables to confidence test scores was examined for both types of confidence testing. The major finding was that while scoring was somewhat more time consuming, end of block examination grades improved slightly and the number of remediations required declined slightly when either confidence testing method was employed. Other areas of investigation produced essentially null results.--*Auth.*

Keseman, Charles E. "A Comparison of the Effect of Three Evaluation Approaches Upon Student Achievement in College Level Drafting" (Doctoral thesis), University of Missouri, Columbia, Miss., 1967.

EVALUATION

INNOVATION	An Algorithm for the Design of Performance Criteria
PROBLEM	The present systems analysis of training manual does not provide much guidance as regards the strategies used in selecting appropriate work performance measurement strategies. Many of the program designers will be first-line supervisor/trainers, who are job-qualified, but who are not training experts. Procedures are needed to help them select the best strategy.
SOLUTION	A simple algorithm (to be incorporated into the Air Force Instructional System Development manual) that would help those responsible for the design of training programs to select appropriate performance-measurement strategies.
ADVANTAGES	Decision making by those responsible for the systems analysis of Air Force training programs would be easier.
RESOURCE REQUIREMENTS	The previously developed algorithm should be expanded in scope and incorporated into a new chapter of the manual when it is routinely revised.
SELECTED REFERENCES	Angell, David, Shearer, James W., and Berliner, David C. *Study of Training Performance Evaluation Techniques*, prepared by American Institutes for Research, Palo Alto, Calif., for the U.S. Naval Training Device Center, Port Washington, New York, 16 October 1964. Finch, Curtis R. and Impellitteri, Joseph T. "The Development of Valid Work Performance Measures," *Journal of Industrial Teacher Education*, Vol. 9, No. 1, Fall 1971, pp. 36-49. McKnight, A. James. "Work Unit Stock: Development of Training Management Procedures for Heterogeneous Ability Groups," in *Use of Job and Task Analysis in Training*, the George Washington University, Human Resources Research Office, HumRRO Professional Paper 1-69, January 1969, pp. 4-11. (Presentations at Headquarters, U.S. Continental Army Command, Fort Monroe, Va., October 1968.) (AD 688 810) This paper records the four presentations on the "Use of Job and Task Analysis in Training" made by members of the HumRRO staff at a briefing sponsored by the Office of the Deputy Chief of Staff for Individual Training at

Headquarters, U.S. Continental Army Command in October 1968. The presentations specifically describe job and task analysis and its role in curriculum engineering. The briefing was designated the first of a series of briefings on training research and development programs of the U.S. Army Behavioral Science Research Laboratory, the Center for Research in Social Systems, and HumRRO.--*Auth.*

Schriber, Peter E. (Pennsylvania State University.) *An Empirical Comparison of Criterion-Referenced Data Collected by Mastery Testing Versus Repeated Item-Examinee Sampling,* 1973. (Paper presented at the annual meeting of the American Educational Research Association, New Orleans, 1973, as part of the Symposium on "Criterion-Reference Evaluation Using Time-Series Designs and Item-Examinee Sampling.")

Siegel, Arthur I., Schultz, D.G., and Federman, Philip. *Post-Training Performance Criterion Development and Application: A Matrix Method for the Evaluation of Training,* prepared for the Personnel and Training Branch, Office of Naval Research, by Applied Psychological Services, Wayne, Pa., January 1961.

EVALUATION

INNOVATION	Management by Objectives Programs for E6s and Above
PROBLEM	Most E6s and above really need management training rather than technical training. Yet, the current training regulations require that records be maintained on jobs, or Specialty Training Standards. The requirement is often ignored, since such records are not relevant to the real training needs of the trainees. Meanwhile, important training objectives that should be considered are not discussed.
SOLUTION	Drop the requirement for keeping records in terms of STS categories for E6s and above; replace it with a management-by-objectives program patterned after those that are so successful in industry. These programs operate by establishing expected performance objectives (with clear-cut standards of performance) during joint planning conferences attended by a supervisor and his subordinate. The progress of the subordinate during a specified period of time is then reviewed in terms of the agreed upon standards of performance, and new objectives are established for the next reporting period.
ADVANTAGES	More meaningful training plans and training records for E6s and above, with consequent increases in the quality of training.
RESOURCE REQUIREMENTS	Research is needed to design and field test a management-by-objectives approach for noncommissioned officers. Time requirements during planning conferences should average approximately one-half hour each. This is more time than is taken today, because many people do not take the present requirements seriously.
SELECTED REFERENCES	Odiorne, George S. (University of Utah). *Training by Objectives: An Economic Approach to Management Training.* The Macmillan Company, New York, 1970, 354 pp. Pajer, Robert G. "A Systems Approach to Results-Oriented Performance Evaluation," *Personnel Administration and Public Personnel Review*, Vol. 1, No. 3, November-December 1972, pp. 42-47.

EVALUATION

INNOVATION Results-Oriented Procedures for Headquarters Evaluations of Training Programs

PROBLEM Inspector General and MAJCOM inspection teams tend to put too much emphasis on record-keeping procedures when they evaluate OJT programs. This has a number of unintended consequences (e.g., falsification of records), and generates resentment on the part of supervisors who have outstanding training programs but who have not had time to maintain their records properly. Some of the record-keeping practices, moreover, are rather trivial in nature (e.g., a supervisor could be written up for making an entry in pencil rather than in ink, or vice versa).

SOLUTION Design new results-oriented procedures for evaluating OJT programs of the type that have a demonstrable relationship to organizational unit objectives.

ADVANTAGES The present overemphasis upon the details of record-keeping procedures would decrease; attitudes towards the OJT program would improve; and the real quality (rather than the paper-work appearance) of OJT programs would be evaluated by inspection teams, resulting in improvements in program quality as opposed to improvements in paper work.

RESOURCE REQUIREMENTS A fairly large-scale research study would be needed to identify new inspection procedures that could be used by Air Force inspection teams. A minimum of 20 squadrons would be needed for a definitive study, and much preliminary work would be needed first. Manpower requirements are projected at three man-years.

SELECTED REFERENCES Warren, M.W. "Analysis of Training Needs," Chapter 4 in Warren, M.W., *Training for Results: A Systems Approach to the Development of Human Resources in Industry*, Addison-Wesley, Reading, Mass., 1969, pp. 47-66.

Warren, M.W. "Administrative Skills Training," in Warren, M.W., *Training for Results: A Systems Approach to the Development of Human Resources in Industry*, Addison-Wesley, Reading, Mass., 1969, pp. 149-150.

EVALUATION

INNOVATION	More Use of Criterion-Referenced Measurement in the Design of End-of-Course Examinations and Specialty Knowledge Tests
PROBLEM	End-of-course examinations and Specialty Knowledge Tests tend to be norm-referenced rather than criterion-referenced; i.e., Air Force personnel often pass examinations because they get higher scores than other personnel, rather than because they can meet the requirements of the position. This is especially true of SKTs, in which those with the highest scores tend to get promoted as part of the WAPS program. The difficulty with norm-referenced testing is that it tends to put too much emphasis on verbal skills and memory--these, moreover, are more likely to be valued by and characteristic of middle-class Americans than they are of lower-class Americans. Thus, it can be argued that the tests are discriminatory. Recent Supreme Court rulings have held that many tests of this type are discriminatory, which gives the whole matter some priority.
SOLUTION	Conduct research to identify criteria for deciding when verbal memory tests should be permitted and when they should not. Identify which tests are inadequate by these criteria, then design criterion-referenced tests for those cases in which the verbal memory tests are considered inadequate or unfair.
ADVANTAGES	Improved fairness and demonstrable job relevance of tests.
RESOURCE REQUIREMENTS	Approximately 200 man-years of effort would be required to design performance standards for all Air Force specialties and convert them into criterion-referenced tests. Assuming that only 25 percent really need it, the total costs are estimated at 50 man-years.
COMMENT	The Air Force is embarked upon a large-scale effort called "systems analysis of training" that could conceivably result in a large number of criterion-referenced tests. But, if Air Force budgets are cut in accordance with present plans, it will probably be decided, in most cases, that criterion-referenced tests are too expensive.

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Glaser, Robert A. "A Criterion-Referenced Test," in Popham, W. James (ed.), *Criterion-Referenced Measurement, An Introduction*, Educational Technology Publications, Englewood Cliffs, N.J., 1971, pp. 41-51.

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Glaser, Robert and Klaus, David J. "Proficiency Measurement: Assessing Human Performance," in Gagné, R.M. (ed.), *Psychological Principles in System Development*, Holt, Rinehart and Winston, New York, 1962, pp. 419-474.

Popham, W. James (ed.), *Criterion-Referenced Measurement, An Introduction*, Educational Technology Publications, Englewood Cliffs, N.J., 1971.

Popham, W. James and Husek, T.R. "Implications of Criterion-Referenced Measurement," in Popham, W. James (ed.), *Criterion-Referenced Measurement, An Introduction*, Educational Technology Publications, Englewood Cliffs, N.J., 1971, pp. 17-37. (*See also* same title, *Journal of Educational Measurement*, Vol. 6, No. 1, Spring 1969, pp. 1-9.)

Shriver, E.L. (Principal Investigator) and Hitchcock, C.D. (Associate Investigator). "Field Tryout and Evaluation of Job-Task Performance Tests," in *Work Unit Summaries*, Defense Documentation Center, Defense Supply Agency, Alexandria, Va., DDC Report No. CT9150, 22 August 1972, p. 44. (Performing Organization: U. R. S. Corp., San Mateo, Calif.; Contract No. F33615-70-C-1695.)

Underwood, B.J. (Principal Investigator). "Personnel Technology: Defining the Conditions Which Control How Well Text Material Is Learned and How Long It Is Remembered," in *Work Unit Summaries*, Defense Documentation Center, Defense Supply Agency, Alexandria, Va., DDC Report No CT9150, 22 August 1972, p. 121. (Performing Organization: Northwestern University Psychology Department, Evanston, Ill.; Contract No. N00014-67-A-0356-0010.)

INCENTIVES-MOTIVATION

INNOVATION	Written Training Contracts Between Instructors and Trainees
PROBLEM	Trainees have little control over their training, consequently they do not have as personal a commitment to achieve training objectives as they might have if they were more involved in the goal-setting process.
SOLUTION	Written training contracts between instructors and trainees, in which the trainee requests training in certain tasks (or CDC volumes), and commits himself to a certain time span for learning those tasks (or CDC volumes).
ADVANTAGES	Improved motivation on the part of trainees; more involvement of trainees in the training process; improved selection of tasks to meet the needs of trainees.
RESOURCE REQUIREMENTS	This idea needs to be elaborated upon and field-tested before it is implemented. Resource requirements for the development and evaluation work are estimated at two man-years. Implementation costs are estimated at one-half hour per trainee.
SELECTED REFERENCES	Bialek, Hilton and McNeil, Michael. *Preliminary Study of Motivation and Incentives in Basic Combat Training*, Technical Report 68-6, The George Washington University, Human Resources Research Office, HumRRO Division No. 3, Presidio of Monterey, Calif., May 1968. Teel, Dean A. "A Comparison of Methods Utilizing the Contract Approach in Teaching Beginning Electricity-Electronics Fundamentals to College Students" (Doctoral thesis), Texas A&M University, College Station, Texas, 1967.

INSTRUCTIONAL TECHNIQUES

INNOVATION	Performance-Based Instruction Techniques
PROBLEM	The Air Force currently handles subject matter training separately from proficiency training, as a basic concept of the dual-channel OJT concept. In fact, there are many advantages in integrating the two types of training so that the trainee can acquire information in job-relevant situations. The situation is complicated by supervisors being expected to design proficiency tests of their own. Consequently, there is no consistent standard, except for the STS requirements. There is considerable duplication of effort by supervisors at different locations.
SOLUTION	Design performance tests with specified behavioral performance standards and use these tests for proficiency training at the outset rather than waiting for some preliminary period of instruction.
ADVANTAGES	Students learn in a job-related situation; each student is required to reach a standard of performance in each skill; emphasis is on active skill performance, not passive absorption of information; student motivation is consequently better than usual.
RESOURCE REQUIREMENTS	Behavioral objectives are expected to result from the Air Force systems analysis of training movement that is currently in progress. The conversion of these behavioral objectives to performance-based instruction techniques would require about $10,000 per specialty. This cost and that of printing and disseminating the information would be less expensive. There is reason to believe that there is a considerable duplication of effort in the present approach.
SELECTED REFERENCES	Taylor, John E., Michaels, Eugene R., and Brennan, Mark F. *The Concepts of Performance-Oriented Instruction Used in Developing the Experimental Volunteer Army Training Program*, HumRRO Technical Report 72-7, Human Resources Research Organization, HumRRO Division No. 3, Presidio of Monterey, Calif., March 1972.

This report describes the planning and implementing of the Experimental Volunteer Army Training Program (EVATP) at Fort Ord early in 1971. This was the Army's first effort to effect major training innovations in the conversion toward an all-volunteer Army. By the fall of 1971, this program was being used as a model for implementing the EVATP at other Army Training Centers. In developing the EVATP system, six established learning principles were applied to Basic Combat Training and Advanced Individual Training to modify the conventional training system. Course objectives and performance tests used were developed jointly by Fort Ord and HumRRO. In a comparison with a conventionally trained group, independently conducted by the Infantry School at Fort Benning, EVATP graduates performed significantly better on five out of seven BCT subjects, and seven out of nine AIT subjects. In general, these gains were shown by men at all levels of aptitude.--*Auth.*

COMMENT

The notion of modularizing training can also be employed to make objectives more job-relevant and performance-oriented. The Army's "duty module" concept is an example of what can be done with this approach.

ADDITIONAL REFERENCES

Miller, Robert B. (American Institutes for Research, Washington, D.C.). *A Taxonomic Base for Future Management Information and Decision Systems: Theoretical Background to the Design of Duty Modules*, prepared for U.S. Army Behavior and Systems Research Laboratory, Office of Chief of Research and Development, Department of the Army (Technical Research Note, July 1971, unpublished).

Stephenson, Robert W. (American Institutes for Research, Washington, D.C.). *A Taxonomic Base for Future Management Information and Decision Systems: A Common Language for Resources and Requirement Planning*, Technical Research Note 244, prepared for U.S. Army Behavior and Systems Research Laboratory, Office of Chief of Research and Development, Department of the Army, October 1972. (AD 757 794)

INSTRUCTIONAL TECHNIQUES

INNOVATION	Peer Instruction
PROBLEM	Individualized rates of instruction are preferable, because slow learners can work at a comfortable pace, and fast learners are not forced to wait for the slower ones, thereby wasting their time. It is not practical to have a separate instructor for each aptitude level of personnel; but lower-aptitude personnel seem to need more help and assistance than higher-aptitude personnel.
SOLUTION	Use fellow trainees as instructors (peer instructors) when performance criteria are well defined. Unusually bright students can be used in most cases, but it seems to be desirable to use a low-aptitude trainee who has completed a block of instruction, especially when the problem seems to be the attitude of another low-aptitude trainee who has not completed training.
ADVANTAGES	Individualized instruction is made practical under many circumstances that would not permit it otherwise; lower-aptitude personnel get more help.
RESOURCE REQUIREMENTS	The effectiveness of this approach depends upon circumstances, so each experiment with it is just that--an experiment. Initial development costs could be high (perhaps two man-years), but the potential for increased OJT capacity and individualization is worth evaluating.
COMMENT	This approach should only be used when performance criteria are well defined. The peer instructors cannot be permitted to certify completion of training, and those who do certify completion must have some opportunity to observe the trainee.
SELECTED REFERENCES	Human Resources Research Organization. "Peer Instruction," *Training in Business and Industry*, Vol. 9, No. 3, March 1972, pp. 38-42. Weingarten, Kenneth *et al. The Apstrat Instructional Model*, HumRRO Professional Paper 6-71, Human Resources Research Organization, Alexandria, Va., May 1971.

Weingarten, Kenneth; Hungerland, Jacklyn; Brennan, Mark; and Allred, Brent. *The Development of a Low-Cost Performance-Oriented Training Model*, HumRRO Professional Paper 32-70, Human Resources Research Organization, Alexandria, Va., December 1970. (Paper presented at the American Psychological Association Convention, Miami Beach, Fla., September 1970.)

This paper describes a training model featuring peer instruction in a functional job-simulated context, at well as the objectives and practical constraints that led to its development.--*Auth.*

Air Force Human Resources Laboratory. "Research to Identify and Evaluate Peer Instruction Applications for Air Force Technical Training," in *Work Unit Summaries*, Defense Documentation Center, Alexandria, Va., DDC Report No. Z00966, 5 March 1974, p.8. (Performing Organization: Air Force Human Resources Laboratory, Lowry AFB, Colo.)

INSTRUCTIONAL TECHNIQUES

INNOVATION Utilization of Talent Ratings to Identify Problem Specialties

PROBLEM The Airman's interest in his job and the felt utilization of talent varies markedly from specialty to specialty, even though each specialty has similar promotion prospects, and the various specialties are relatively the same. Trainees who are assigned to the lower interest specialties (which must be assigned to someone) tend to get bitter and leave the Air Force after their first enlistment. If they do not leave, they will request reassignment and retraining into another specialty as soon as they have met their minimum time requirements. Either action is expensive for the Air Force.

SOLUTION Scales measuring job interest and utilization of talent have been placed in all Air Force Occupational Surveys administered since 1966. These data can be analyzed and used to identify problem specialties that require remedial action of some kind.

RESOURCE REQUIREMENTS Periodic statistical analyses of job interest and felt utilization of talent ratings by various groups of trainees must be followed up by special studies that would identify the exact problem. Some studies may be a matter of a few man-weeks by a committee, but others could conceivably involve large-scale field surveys with a representative sample of airmen in the specialty.

ADVANTAGES Improved retention and job satisfaction of Air Force personnel in the specialties affected.

COMMENT There is often a separation of personnel research and personnel operations groups that acts as a hindrance to the implementation of research findings. This should be considered when study teams are established.

SELECTED REFERENCES Christal, Raymond E. *Analysis of Racial Differences in Terms of Work Assignments, Job Interest, and Felt Utilization of Talents and Training*, AFHRL-TR-72-1, Personnel Research Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, January 1972. AD-741 758.

This study reports data analyses for first-term airmen in 11 career ladders to determine whether there are differences in work assignments and job attitudes of Blacks and Non-Blacks. The general approach involved application of the multiple linear regression model to determine the relationships between race and selected criteria, holding constant such variables as aptitude, time in military service, technical school graduation status, and time on the job. No racial differences were observed in the number of tasks being performed or in the average difficulty of tasks performed per unit time. However, when these two factors were weighted into an overall job difficulty composite, it was found that the Blacks were performing slightly less difficult jobs in two of the career ladders: 605X0 Air Passenger/Air Cargo and 702X0 Administrative. Significant differences in job interest and felt utilization were found in two ladders, 291X0 Communications Center and 702X0 Administrative; in each instance, these differences were in the direction of Blacks finding their jobs more interesting and feeling a greater utilization of their talents and training than Non-Blacks. Only a small proportion of the job assignment variance could be accounted for by all variables in the system. The unique contribution of race was significant in two ladders, but in each instance this contribution was less than one percent. There appear to be no practical differences in the types of assignments given to Blacks and Non-Blacks in the 11 ladders investigated. Blacks in the 291X0 and 702X0 areas reported higher job interests and a higher feeling of utilization. Again, these differences were significant, but were relatively small.--*Auth.*

Gould, R. Bruce. *Reported Job Interest and Perceived Utilization of Talents and Training by Airmen in 97 Career Ladders*, AFHRL-TR-72-7. Personnel Research Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, January 1972. AD-745 099.

The purpose of this study was to investigate the extent of differences in reported job satisfaction of over 100,000 airmen in 97 career ladders. The differences between career ladders and between individuals within career ladders were evaluated. Two seven-point scales measuring incumbents' job interest and feelings of how well their jobs make use of their talents and training have been included in inventories administered under the USAF Occupational Survey Program. Analyses of the responses indicated that while most airmen found their jobs interesting and felt well utilized, there were some extreme differences between career ladders and among individuals within ladders. Extensive ladder by ladder studies are warranted to identify factors relating to differences in job satisfaction.--*Auth.*

PERIODIC SURVEYS

INNOVATION	Periodic Surveys of Trainees
PROBLEM	Trainees have a great deal of information about the quality of training when they are undergoing OJT, but the information is not collected in a systematic manner or used to make decisions. Part of the problem is that the official communication channels are too formal and too serious for a trainee to feel comfortable using them.
SOLUTION	Conduct periodic surveys and anonymous interviews with trainees in which they are asked to rate the quality of their training while in OJT; identify problem areas; suggest improvements.
ADVANTAGES	Anonymous interviews will permit trainees to "blow off steam," as well as communicate information to people who are in a position to solve problems. Anonymous questionnaires have a similar effect. Both types of survey are also proof that the Air Force is concerned about the welfare and job satisfaction of its trainees. More importantly, however, information would be collected that would permit improvements in the Air Force OJT program.
RESOURCE REQUIREMENTS	Only a small sample of trainees need be interviewed. If the interviews are conducted by CBPO OJT personnel, it is estimated that 100 interviews per year would be sufficient at each large base. The CBPO OJT staff, in turn, could be asked to prepare an anonymous report, once every six months, in which potential problem areas would be identified and recommendations would be made for modifying the base OJT effort. The surveys should be conducted on an Air Force-wide basis, and should involve a sample of at least 100 trainees in every MAJCOM.
SELECTED REFERENCES	Gessner, Peter K. "Evaluation of Instruction," *Science*, Vol. 180, No. 408C, 11 May 1973, pp. 566-670. It appears quite clear that student ratings of instruction and class performance on national normative examinations are postively related: the higher the student ratings of the instruction they receive, the higher the class score relative to a nationwide norm. On the other hand, no significant relationship exists between student

ratings and class performance on institutional examinations. This suggests that both student ratings and class performance on national normative examinations are valid measures of teaching effectiveness.--*Auth.*

PROGRAM DESIGN

INNOVATION Use of More Illustrations and More Simple Language in Technical Manuals and CDCs

PROBLEM Many technical manuals have relatively few illustrations and are written at higher reading levels than most Airmen in a specialty can readily comprehend.

SOLUTION Use more illustrations and more simple language in technical orders, CDCs, and other job-related publications.

ADVANTAGES Improved understanding and retention on the part of trainees, especially those with low aptitude.

RESOURCE REQUIREMENTS Editing materials for readability and more simple language could cost approximately $5,000 per text. Additional illustration costs would vary from publication to publication.

COMMENT Revising CDCs will not help if there is no allowance for the technical manuals to be written at a lower reading level. It seems logical to begin with the technical manuals required for job performance. If they cannot be improved, the Air Force should increase the ability standards for the men assigned.

SELECTED REFERENCES Sellman, Wayne S. *Effectiveness of Experimental Training Materials for Low Ability Airmen*, AFHRL-TR-70-16, Technical Training Division, Air Force Human Resources Laboratory, Lowry AFB, Colo., June 1970. AD-717 712.

The study was designed to determine if modifying Career Development Course (CDC) format through the simplification of the written materials, the inclusion of more illustrations, and the addition of audio supplementation could improve the CDC as a training device designed to teach basic job information, especially to airmen possessing minimum verbal skills. High-, middle-, and low-aptitude personnel studied three versions of the CDC for the 57130, fire protection, career ladder. In brief, the versions included a conventional CDC, a less verbal CDC with more pictorial materials, and a less verbal CDC with more pictorial materials accompanied by a tape recording of information complementary to that contained in the written text of the CDC. Data were collected on learning performance, reading speeds, and attitudes toward the CDC. The analyses revealed that the modified CDC with the audio supplementation produced significantly increased learning scores. High- and middle-aptitude groups consistently outperformed the low-aptitude groups across all CDCs.--*Auth*.

PROGRAM DESIGN

INNOVATION Consider the Use of Job Performance Aids as an Integral Part of the Process by Which Training Programs Are Designed.

PROBLEM Training programs and job-performance aids tend to be designed by different people and with relatively little coordination. As a result, some training design problems that could be solved through the use of job performance aids are either otherwise resolved or not resolved at all.

SOLUTION Require that those responsible for the design of training programs be trained in the design of job-performance aids, and be kept informed regarding the plans of other Air Force agencies for job-performance aids so that they might be able to use them effectively.

ADVANTAGES Simplification of training requirements where job-training aids can help, thus resulting in a savings in training time and possible increases in efficiency.

RESOURCE REQUIREMENTS An additional three days would be needed in the training programs currently taken by technical writers/instructors. Some TDY would also be needed for conterences between job-performance experts and training-program designers.

SELECTED REFERENCES Chalupsky, Albert B. and Kopf, Thomas J. *Job Performance Aids and Their Impact on Manpower Utilization*, WDL-TR-3276, prepared for Office Manpower Policy, Evaluation and Research, U.S. Department of Labor, by Philco-Ford Corporation, WDL Division, Palo Alto, Calif., May 1967.

Chenzoff, Andrew P., Mallory, William J., and Joyce, Reid P. (Applied Science Associates, Inc.). *Guidance and Specification for the Preparation of Fully Proceduralized Job Aids for Organizational and Intermediate Maintenance of Electronic Subsystems*, Technical Report AFHRL-TR-71-23, Air Force Human Resources Laboratory, Brooks AFB, Texas, June 1971. AD-731 144.

This report supplies a model for specification for the preparation of fully proceduralized job aids for organizational and intermediate maintenance of electronic subsystems, and offers guidance in the preparation of such aids. The aids to be developed from these specifications are for flight-line or field-shop maintenance of any electronic subsystem, and support the performance of the following maintenance functions as needed: checkout, alignment, repair, adjustment, calibration, malfunction localization, malfunction isolation, and the removal and replacement of malfunctioning equipment items.--*Auth.*

Foley, John P., Jr. *Job Performance Aids Research, Summary, and Recommendations*, Air Force Human Resources Laboratory, Wright-Patterson AFB, Ohio, April 1969. (AD 697 034)

Gebhard, Richard M. *Development of a Training Program and Job Aids for Maintenance of Electronic Communication Equipment*, Human Resources Research Organization, HumRRO Division No. 1, Alexandria, Va., Technical Report 70-19, December 1970.

This study was designed to develop and evaluate methods for producing a combination of training and job aids (manuals) for maintenance of electronic communication equipment that would require less training time than the standard course and manuals.--*Auth.*

Hoehn, Arthur J. and Lumsdaine, Arthur A. *Design and Use of Job Aids for Communicating Technical Information*, Technical Report AFPTRC-TR-58-7, Maintenance Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Lowry AFB, Colo., January 1958. (AD 152 109)

Serendipity, Inc. *Project PIMO Final Report: PIMO Final Report Summary*, May 1969. (AD 852 101)

Singer, E.J. and MacDonald, I.D. *Is Apprenticeship Outdated?*, Institute of Personnel Management, Oxford Circus, London, 1970.

PROGRAM DESIGN

INNOVATION	Provide Task Difficulty Ratings to Those Responsible for OJT
PROBLEM	Every supervisor in the Air Force is expected to act as a trainer for his subordinates, even when he has not had previous experience in the tasks for which he is providing training. As a result, some trainees are assigned tasks that are too difficult or too easy for their state of progress.
SOLUTION	A procedure for collecting task difficulty ratings has been designed by the Air Force Personnel Laboratory. These procedures could be applied to STS categories when STSs are reviewed and revised on a routine basis. The information could then be systematically incorporated into the STSs, and used to guide inexperienced supervisor/trainers.
RESOURCE REQUIREMENTS	Approximately two man-days of committee time for each specialty would be required when the STSs are routinely reviewed by a panel of NCOs. No printing costs would be involved if the changes were restricted to new or revised STSs.
ADVANTAGES	More appropriate assignments for trainees at various levels of skill and aptitude.
COMMENT	This sort of information is not needed by experienced trainers. There may also be restrictive conditions that make some tasks more difficult than the panel of experts would normally have expected them to be.
SELECTED REFERENCES	Lecznar, William B. *Three Methods for Estimating Difficulty of Job Tasks*, AFHRL-TR-71-30, Personnel Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, July 1971. AD-730 594. The numbers and ability levels of persons who might enlist in the Air Force can be projected only within gross boundaries. It is necessary, however, to make optimal use of whatever manpower is available in the enlisted force. An important tool for this purpose is accurate information about the difficulty of tasks that make up Air Force jobs and the abilities of airmen assigned to perform those tasks. This study explores two methods of obtaining estimates of task difficulty and evaluates the comparative merits of the methods.

Using the Medical Materiel Career Ladder (915X0) job inventory as the vehicle for the study, senior noncommissioned officers judged each of the task statements on a relative scale of difficulty. A second group of NCOs rank ordered the tasks according to their estimates of difficulty. The tasks were then arranged according to the average grade level of airmen who stated they performed each task. A mathematical estimate was made of the agreement on task difficulty within the group of raters, within the group of rankers, and between the difficulty orders established by ratings, rankings, and grade. Considerable agreement was found among both the raters and the rankers as to the difficulty of tasks. The relationship between rated difficulty and ranked difficulty was substantial and was higher than either of these with the order of tasks based on average grade level. The study did not, however, treat the question of the accuracy of any of the judgments. A number of studies in Air Force occupational research depend upon judgments of workers in various career ladders. It seems clear that the method of rating a large number of items on a relative scale will provide data from pooled judgments which can be used with confidence and which can be obtained with less time expenditure than that required for rank ordering. Because of the lower relationships obtained, use of average grade as an index of task difficulty does not appear warranted for general application to evaluation of task attributes.--*Auth.*

Mead, Donald F. *Continuation Study on Development of a Method for Evaluating Job Difficulty*, AFHRL-TR-70-43, Personnel Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, November 1970. AD-720 254.

There has been no tool available by which Air Force personnel managers could evaluate jobs in terms of their ordering on specified dimensions for use in various policy and decision making situations. The problem attacked in this study was to determine whether supervisors' judgments of job difficulty (as one specific dimension) could be predicted with sufficient accuracy from certain information readily accessible. With the Medical Career Ladder as the area for study, senior noncommissioned officers were asked to rank order actual jobs performed by airmen in the ladder; other NCOs were asked to provide ratings of difficulty on a relative scale for each of the tasks listed in the job inventory previously developed for the ladder. Through application of statistical techniques, the rankings, ratings, and other closely related data were treated to yield a prediction system. The stability of the system was then tested. From 21 variables and 17 multiple regression problems, an optimally weighted equation was derived which apparently captured the policy used by the judges in rank ordering the jobs on estimated difficulty. The equation contained three predictors: Number of Tasks Performed, Average Task Difficulty per Unit Time Spent, and Number of Tasks Performed, Squared; an R of .95 and an R^2 of .90 were obtained between the predicted job difficulty values and the judged job difficulty ranks. Cross-application of the equation to test for stability yielded an R of .94 in both samples. Further analysis of the predicted values showed that 90 percent were within ± 2.75 points of the ranked values (on a scale of 1 through 25). The study indicates that the job difficulty equation derived from information easily collected by means of job inventories will predict ranked job difficulty with a high degree of accuracy, at least in the Medical Materiel Career Ladder. If further research in other career ladders verified the same constituent elements with similar weights, it will be possible to have an index of difficulty for each job in all airman career fields. The implication is that the Air Force personnel system would be given material assistance toward establishing grade requirements, in considering job aptitude minimums, for comparing work assigned to various categories of personnel, and other related personnel actions.--*Auth.*

Mead, Donald, F. *Development of an Equation for Evaluating Job Difficulty*, AFHRL-TR-70-42, Personnel Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, November 1970. AD-720 253.

In a prior study an equation was developed which accurately predicted supervisors' judgments of the difficulty of airman jobs in the Medical Materiel Career Ladder. The utility and effectiveness of this tool for Air Force personnel managers would be considerably enhanced if the equation could be generalized to all Air Force specialties. The present study was directed to the question of whether an equation developed on a second specialty, Vehicle Maintenance, had the same or similar characteristics as the earlier one. Rank orderings of a random set of job descriptions, based on job analysis of the Vehicle Maintenance Career Ladder, and difficulty ratings on a 7-point relative scale of each task in the Vehicle Maintenance job inventory were requested of separate groups of noncommissioned officers working in the specialty. By application of a policy-capturing technique, an equation was derived to predict the job difficulty ranks. The Vehicle Maintenance job difficulty equation predicted with a high degree of accuracy ($R = .93$) supervisors' judgments of job difficulty. The primary factors reflected in the supervisory judgment of job description, difficulty level of tasks performed, and time spent performing the tasks. The three basic variables which combined to capture the job difficulty evaluation policy were the same as those in the prior study. On cross-application, the equation showed no appreciable loss in effectiveness. Major findings replicated those in the Medical Materiel study. Apparently common factors exist across career ladders which enter into supervisors' judgments of job difficulty; within each ladder the supervisors' evaluation policy was captured in quantified form. There remains the unresolved question of whether an effective composite standard weight equation can be developed for evaluating jobs in all airman career ladders.--*Auth.*

Mead, Donald F. and Christal, Raymond E. *Development of a Constant Standard Weight Equation for Evaluating Job Difficulty*, AFHRL-TR-70-44, Personnel Division, Air Force Human Resources Laboratory, Lackland AFB, Texas, November 1970. AD-720 255.

Availability of a device which would provide valid measures of some specified important factor in Air Force jobs could be used to improve such features of the Air Force personnel system as assignment-reassignment, career planning, and force development. An initial study developed such a technique for evaluating the factor of job difficulty; a following study verified the procedure in a second career field by replicating the results of the initial research. The present effort, in addition to checking the generalizability of the procedure to a third airman specialty, focused on derivation and test of a "universal" equation that could be given to personnel managers as a simple-to-use effective quantitative indicator of job difficulty. Senior noncommissioned officers in the Accounting and Finance Career Ladder provided their judgments on the rank order difficulty of 250 jobs which were described in terms of actual tasks performed by incumbents. A second group of senior NCOs each rated all the tasks listed in the job inventory for this ladder on a relative scale of difficulty. Statistical techniques were applied to these data to simulate the judges' policy in evaluating job difficulty, to test the efficacy of the derived prediction equation, and then to develop and test a set of standard weights to be assigned to each of the elements in the equation.

The correlation of .95 between supervisors' ranking of job difficulty and predicted values based on the derived equation is highly satisfactory and replicates values-obtained in the two prior studies of different career fields. This study also confirms that the same three predictors found in the prior efforts combined to capture the evaluation policies of supervisors. On the main point of the study, a composite set of standard score weights derived from data in three ladders was demonstrated to provide highly acceptable validity (R = .9479 for Medical Materiel, R = .9247 for Vehicle Maintenance, and R = .9460 for Accounting and Finance). Differences between these values and validities yielded by optimal equations developed within the three ladders (.9486, .9269, and .9511, respectively) were nonsignificant. The indications are that the "universal" equation can be used to obtain difficulty values for jobs across the total airman classification structure as quickly as occupational surveys are constructed and administered; only task difficulty values would have to be provided, and that aspect could be built into current job specialty surveys. The system is relatively free of external influences. Its most outstanding feature is the quantitative format which lends itself to existing automated data processing. The implications are significant when one considers possible application of the system to use in reassignment systems, in establishment of aptitude requirements, in comparison of work assigned to various categories of input (such as directed duty assignees, by-pass specialists, or technical school graduates), in investigation of interaction between job difficulty, job satisfaction, and career intent, and in guidance of policy on force composition.

Miller, Robert B. "Task Description and Analysis," in R.M. Gagné (ed.), *Psychological Principles in System Development*, Holt, Rinehart and Winston, New York, 1962, pp. 187-228.

PROGRAM DESIGN

INNOVATION Decision Tables That Suggest Different Training Procedures for Different Kinds of Tasks

PROBLEM Many options exist, and it is difficult to decide which training procedures should be used under which circumstances.

SOLUTION Decision tables are to be based upon the following five categories of information:

(1) The extent to which each of five defined "ongoing activities" is involved in the task;
(2) The temporal, sequential, and casual relationships among these activities;
(3) Characteristics of the detailed behavior that constitute the activities;
(4) Contingencies that might affect task performance;
(5) Disruptive conditions under which the task might have to be performed.

The five ongoing activities include (a) Procedure Following, (b) Continuous Perceptual Motor Activity, (c) Monitoring, (d) Communicating, (e) Decision Making and Problem Solving.

ADVANTAGES Expert decisions can be made by personnel who are not well read in the field.

RESOURCE REQUIREMENTS Existing procedures can be incorporated into training manuals; new procedures could also be designed, but would require research.

SELECTED REFERENCES Folley, John D., Jr. (Applied Science Associates, Inc.). *Development of an Improved Method of Task Analysis and Beginnings of a Theory of Training,* Technical Report NAVTRADEVCEN 1218-1, prepared for U.S. Naval Training Devices Center, Port Washington, New York, 22 June 1964.

Haggard, Donald F. (U.S. Army Armor Human Research Unit, Fort Knox, Kentucky). *The Feasibility of Developing a Task Classification Structure for Ordering Training Principles and Training Content,* The George Washington University, Human Resources Research Office, Research Memorandum, January 1963.

PROGRAM DESIGN

INNOVATION	Revise STSs So That Certain Tasks Are Required
PROBLEM	Under the Air Force dual-channel system of OJT, the supervisor can, if he chooses, assign a single task to a trainee, and still get the trainee upgraded to the 5-skill level. The situation is complicated by the fact that some isolated Air Force locations do not have the equipment or the available supervisor/trainer time in order to provide training in a reasonable variety of tasks. As a result, some of those upgraded to the 5-skill level are really not qualified, and they may not have received training in important safety procedures.
SOLUTION	Establish flexible minimum training goals for selected specialties and skill levels. This may take the form of listing a set of important tasks on the first page of the STS, and then requiring that some certain number (e.g., 3 out of 10) must be learned by any trainee upgraded to the 5-skill level.
ADVANTAGES	Trainees who transfer from one location to another will be more able to perform at their officially recognized skill level.
RESOURCE REQUIREMENTS	Changes could be implemented when STSs are revised or reviewed on a routine basis.
COMMENT	Locations that are not able to provide the type of training that is needed would be assigned personnel who are already qualified.
SELECTED REFERENCES	Elkin, Albert (U.S. Army Infantry Human Research Unit, Fort Benning, Ga.). *The Development of a List of Minimal Training Goals for Basic Combat Training*, HumRRO Technical Report 67, The George Washington University, Human Resources Research Office, December 1960. The Basic Combat Training Program (ATP 21-114, Nov 58) was analyzed in relation to each of 17 supporting Army Subject Schedules. Discrepancies between the ATP and its referenced subject schedules were noted and revisions suggested. On the basis of this analysis, a list of minimum training goals was devised for each subject presented in the report. These suggested training goals cover the minimum knowledge and skills needed by the individual basic combat trainee.--*Auth*.

PROGRAM DESIGN

INNOVATION	Procedures for Deciding Which Training Techniques Should Be Used for Personnel at Different Aptitude Levels
PROBLEM	The best strategy to use in training someone seems to depend upon his aptitude level. High-aptitude personnel learn faster, need less guidance and repetition of instruction--but the differences vary from one type of task to another. Research conducted as a result of Project 100,000 has identified many specific conditions under which additional guidance and repetition is needed, but decision tables based upon the characteristics of the task have not been designed.
SOLUTION	Design decision tables for deciding which training techniques should be used for personnel at different aptitude levels, and incorporate them into training manuals for supervisor/trainers.
ADVANTAGES	More consideration for the special training needs of high- and low-aptitude personnel when hands-on training programs are designed.
RESOURCE REQUIREMENTS	Research is needed to design and field test the use of the decision tables.
SELECTED REFERENCES	Fox, W.L., Taylor, John E., and Caylor, John S. *Aptitude Level and the Acquisition of Skills and Knowledges in a Variety of Military Training Tasks*, HumRRO Technical Report 69-6, The George Washington University, Human Resources Research Office, HumRRO Division No. 3, Presidio of Monterey, Calif., May 1969. The Army has the problem of training men of widely differing aptitude levels in a variety of military jobs. Recent Department of Defense decisions to lower mental standards for induction and enlistment to the statutory minimum AFQT score is resulting in a greater concentration of lower aptitude trainees in the Army training program. Increasing the number of low-aptitude trainees will not only make the training job more difficult but may also result in marked loss in performance by the more apt as they become even more bored and restless than evidenced in the past.

Current technology of training provides little information useful to the Armed Forces for designing training programs to accommodate the entire spectrum of aptitude. Although research directed toward engineering of training for those in lower mental Category IV has been started, results are not yet structured or specific enough to tell how to conduct training. With the Army's training population now spread so widely across the spectrum of aptitude, research is needed on the relationship of training performance to aptitude in order to determine what, if any, differential training is required for the efficient production of relatively standard MOS-qualified soldiers.

The relationship between aptitude level and training performance must be clarified before recommendations for increasing training efficiency can be made. This report presents research aimed at providing this information. Specifically, this report deals with the relationship between aptitude level and the acquisition of military skills and knowledges in a variety of training tasks which differ in complexity.--*Auth.*

McFann, Howard H. "Individualization of Army Training," in *Innovations for Training*, HumRRO Professional Paper 6-69, The George Washington University, Human Resources Research Office, HumRRO Division No. 3, Presidio of Monterey, Calif., February 1969. (HumRRO presentation at the USCONARC Training Innovations Conference, Fort Benning, Ga., September 1968.)

Individualization of training is discussed from the aspects of (a) systems engineering, (b) training strategies, and (c) individual training factors. Emphasis is on the latter two, recognizing that the systems engineering approach is a prerequisite for any training system. Four possible training strategies are discussed, including the implications of each for handling individual differences. Training factors to be simultaneously considered in developing a training program that will handle individual differences are described. An attempt is made to interrelate ability level to factors of type of complexity of content, organization and sequencing, material, method and media of instruction, motivation, and management.--*Auth.*

PROGRAM DESIGN

INNOVATION	More Common Core Courses in Selected Subject Matter Areas
PROBLEM	Electronics is basic to many different Air Force specialties, and a number of slightly different courses have been designed. Because of their similarity, there is some duplication of effort in the design of these courses.
SOLUTION	Modify the Army's Common Core Courses for Basic Electronics courses (COBET) for Air Force use.
ADVANTAGES	Less duplication of effort in the design of electronics courses; improved quality of electronics training.
RESOURCE REQUIREMENTS	The Army's course could be adapted for Air Force use with approximately one man-year of effort.
SELECTED REFERENCES	Educational Computer Corporation. *Final Report of SNAP/SMART*, prepared for Manpower Development Training, Department of Labor (Contract No. 82-40-67-56; 1 June 1967-31 August 1969); and Department of Health, Education, and Welfare (Contract No. OEC-0-8-008096-2622(089); 16 January 1968-31 October 1969). Eschenbrenner, J. (Principal Investigator) and Lonigro, J. (Associate Investigator). "Advanced Development Work Resulting in Precision Measuring Equipment (PME) Individualized Instruction Materials," in *Work Unit Summaries*, Defense Documentation Center, Defense Supply Agency, Alexandria, Va., DDC Report No. CT9150, 22 August 1972, p. 31. (Performing Organization: McDonnell Douglas Corp., St. Louis, Mo.; Contract No. F33615-71-C-1846.) Johnson, Frank F., Jr. "Better Learning Management: COBET Offers a Model," *American Vocational Journal*, Vol. 47, No. 4, April 1972. Kratochvil, Daniel W. and Thompson, Lorna J. (American Institutes for Research, Palo Alto, Calif.). *The Cluster Concept Program* (Developed by the University of Maryland, Industrial Education Department), Product Development Report No. 18, prepared for Office of Education, Office of Program Planning and Evaluation, Department of Health, Education, and Welfare, AIR-21900-1/72-TR(18), January 1972.

OTHER

INNOVATION	Adaptation of Air Force Training Materials for Distribution by State Boards of Vocational and Technical Education
PROBLEM	The Air Force invests a great deal of time and effort in keeping its technical training materials up to date--much more so than any State could possibly afford. Yet, the civilian training programs have just as much need to remain up to date as the military.
SOLUTION	It would seem to be in the best interests of the country to at least make Air Force technical training materials available to State Boards of Vocational and Technical Education. Ideally, some federal agency (e.g., HEW) would go beyond this point and fund work on the civilianization of selected Air Force training materials for use by State Boards of Vocational and Technical Education.
ADVANTAGES	Less duplication of effort in the economy; improved training in civilian occupations that relate closely to Air Force needs and interests; increased transferability of civilian skills.
RESOURCE REQUIREMENTS	The cost of civilianizing CDC volumes is estimated from \$10-\$20 thousand each. A similar program has been tried by the Aerospace Education Fndn with promising results.
COMMENT	The selection of courses for civilianization should be made by an organization concerned with national training needs in the civilian sector.
SELECTED REFERENCES	Aerospace Education Foundation. *Vocational Instruction Systems of the Air Force Applied to Civilian Education*, Praeger Publishers, New York, 1971, 128 pp. Mayo, G. Douglas. *Programmed Instruction in Technical Training*, Research Report SRR 69-28, Naval Personnel Research Agency, San Diego, Calif., 1 June 1969. (AD 690 897) Shirley-Smith, K. "The Armed Forces," Chapter 22 in *Programmed Learning in Integrated Industrial Training*, Gower Press, London, 1968, pp. 173-178.

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